SERVICE MANUAL

cardiofax GEM
ELECTROCARDIOGRAPH

ECG-9010K, ECG-9020K
ECG-9020P, ECG-9022K

0634-001307B

NIHON KOHDEN

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Conventions Used in this Manual and Instrument

Warnings, Cautions and Notes

Warnings, cautions and notes are used in this manual to alert or signal the reader to specific information.

WARNING

A warning alerts the user to the possible injury or death associated with the use or misuse of the instrument.

CAUTION

A caution alerts the user to possible injury or problems with the instrument associated with its use or misuse such as instrument malfunction, instrument failure, damage to the instrument, or damage to other property.

NOTE

A note provides specific information, in the form of recommendations, prerequirements, alternative methods or supplemental information.

Explanations of the Symbols in this Manual and Instrument

The following symbols found in this manual/instrument bear the respective descriptions as given.

Cardiograph

Attention, consult operator's manual	Input terminal for analog signal	Type CF applied part
Equipotential terminal	Output terminal for analog signal	The CE mark is a protected conformity mark of European Community. The products herewith comply with the requirements of the Medical Device Directive 93/42/EEC.
Serial input/output terminal	Eject (magazine release button)	

Operation panel (for ECG-9010K onlly)

Alternating current	Age	Filter
"On" only for a part of equipment	REST/PERIODIC recording	Copy
"Off" only for a part of equipment	Paper speed	Calibration
Battery charging (lamp/on screen)	Gain	START/STOP recording
Battery check (lamp/on screen)	Paper feed	Automatic control
QRS sync lamp	Mark	Manual control

Operation panel (for ECG-9020K only)

Alternating current	Age	Filter
"On" only for a part of equipment	Sex	Copy
"Off" only for a part of equipment	Mode	Calibration
Battery charging (lamp/on screen)	Rhythm	START/STOP recording
Battery check (lamp/on screen)	Paper feed	Automatic control
	Mark	Manual control

Display (for ECG-9020K only)

	QRS sync lamp

Patient cable

Attention, consult operator’s manual	Defibrillation-proof Type CF applied part

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Introduction

This service manual provides useful information to qualified service personnel to understand, troubleshoot, service, maintain and repair the ECG-9010K, ECG-9020K/P and ECG-9022K Electrocardiograph (referred to in this service manual as “the instrument”, “ECG-9010K” or “ECG-9020K” which includes ECG-9020P and ECG-9022K).

All replaceable parts or units of this instrument and its optional units are clearly listed with exploded illustration to help you locate the parts quickly.

The System test, Adjustment and Setting section in this service manual describes the maintenance that should be performed by qualified service personnel. The Maintenance section in the operator’s manual describes the maintenance that can be performed by the user.

The information in the operator’s manual is primarily for the user. However, it is important for service personnel to thoroughly read the operator’s manual and service manual before starting to troubleshoot, service, maintain or repair this instrument. This is because service personnel needs to understand the operation of the instrument in order to effectively use the information in the service manual.

Service Policy

Nihon Kohden Corporation's basic policy for technical service is to replace faulty units, printed circuit boards or parts. We do not support component-level repair of boards and units outside the factory for the following reasons:

- A special facility is necessary to repair multi-layer boards because most of the components on the board are SMD (surface mount devices) and most of the circuits employ a gate array method.
- To fulfill safety certification requirements, a special facility is necessary to verify safety as medical equipment after the power unit is repaired.

NOTE

- **When ordering parts or accessories from your nearest Nihon Kohden Corporation's distributor, please quote the NK code number and part name which is listed in this service manual, and the name or model of the unit in which the required part is located. This will help us to promptly attend to your needs.**
- **Always use parts and accessories recommended or supplied by Nihon Kohden Corporation to assure maximum performance from your instrument.**

Specifications

ECG input

Input impedance	10 MΩ or more
Electrode offset tolerance	±500 mV or more
Input unit protection	Isolated and defibrillator protected
Standard sensitivity	10 mm /mV ±2%
Common mode rejection ratio	100 dB or more
Frequency response	0.05 to 150 Hz (– 3 dB or more)

Waveform data processor

Sample rate	500 samples/s (input unit: 8,000 samples/s)
AC line filter	50/60 Hz, OFF
High-cut filter	75, 100, 150 Hz
EMG filter	25/35 Hz
Time constant	3.2 s or more
Waveform status detection	Electrode detachment (polarization voltage), Noise (high frequency)
Sensitivity selection	5, 10 , 20 mm/mV

LCD (monochrome with CCFT backlight) (for ECG-9020K/P, ECG-9022K only)

Size	5.6 inch
Number of dots	320 × 240
ECG waveform	3 channel:Real time 12 ECG lead complexes 6 channel: 2.5 s Rhythm lead: 10 s
Displayed data	Waveform, patient information, recording settings, operation mode, heart rate, QRS sync mark, error message, electrode detachment, noise

Recorder

Printing method	High resolution thermal printer head
Printing density	200 dpi (8 dots/mm)
Scanning line density	1 ms
Recording width	104 mm
Number of recording channels	2, 3, 4, 6
Paper speed	10, 12.5, 25, 50 mm/s (10 and 12.5 mm/s available for ECG-9020K only)
Printed data	Program type, version, date and time, paper speed, sensitivity, lead name, filter, hospital name, patient information, timing mark, event mark, electrode detachment, noise
Mechanical noise	48 dB or less at paper speed 25 mm/s

External input/output

External input	10 mm/0.5 V ±5%, input impedance 100 kΩ or more	
Signal output	0.5 V/1 mV ±5%, output impedance 100 Ω or less	
Serial I/O	Communication method:	RS-232C
	Baud rate:	2400, 4800, 9600, 19200, 38400, 57600, 115200

Power requirement

Line voltage	100 to 127 VAC, 220 to 240 VAC ±10%
Line frequency	50 or 60 Hz
Power input	Up to 120 VA
Power consumption	49 W or less
Built-in battery	Voltage: 12 V
(LCT-1912ANK)	Current consumption: 6A or less

Environment

Operating temperature	10 to 40°C	
Operating humidity	25 to 90% RH	
Operating atmospheric pressure	70 to 106 kPa	
Storage duration and temperature	2 weeks or less:	–20 to 65°C
(Depends on the battery)	Between 2 weeks and One year:	–15 to 40°C
	Over one year:	–15 to 25°C
Storage humidity	10 to 95% RH (non condensing)	
Storage atmospheric pressure	70 to 106 kPa	
Recording paper storage temperature	–20 to 50°C	
Recording paper storage humidity	25 to 90% RH	
Electromagnetic compatibility	Class B	
Other	Indoor portable	

Dimensions and weight

Dimensions	280 W × 52 H × 216 D mm (excluding protrusions)	
Weight	ECG-9010K:	Approx. 1.9 kg (without battery)
	ECG-9020K/P:	Approx. 2.1 kg (without battery)
	ECG-9022K:	Approx. 2.1 kg (without battery)

Safety

Safety standard:

IEC 60601-1 (1988), IEC 60601-1 Amendment 1 (1991), IEC 60601-1 Amendment 2 (1995)
IEC 60601-2-25 (1993), IEC 60601-2-25 Amendment 1 (1999)

Type of protection against electric shock:

AC power: Class I

Batty power: Internally powered equipment

Degree of protection against electric shock:

Defibrillator proof type CF applied part when patient cable BJ-901D, BJ-902D or BJ-903D is used

Degree of protection against harmful ingress of water:

Ordinary equipment

Degree of safety of application in the presence of a flammable anaesthetic mixture with air, oxygen or nitrous oxide:

Not suitable for use in the presence of a flammable anaesthetic mixture with air, oxygen or nitrous oxide

Mode of operation: Continuous

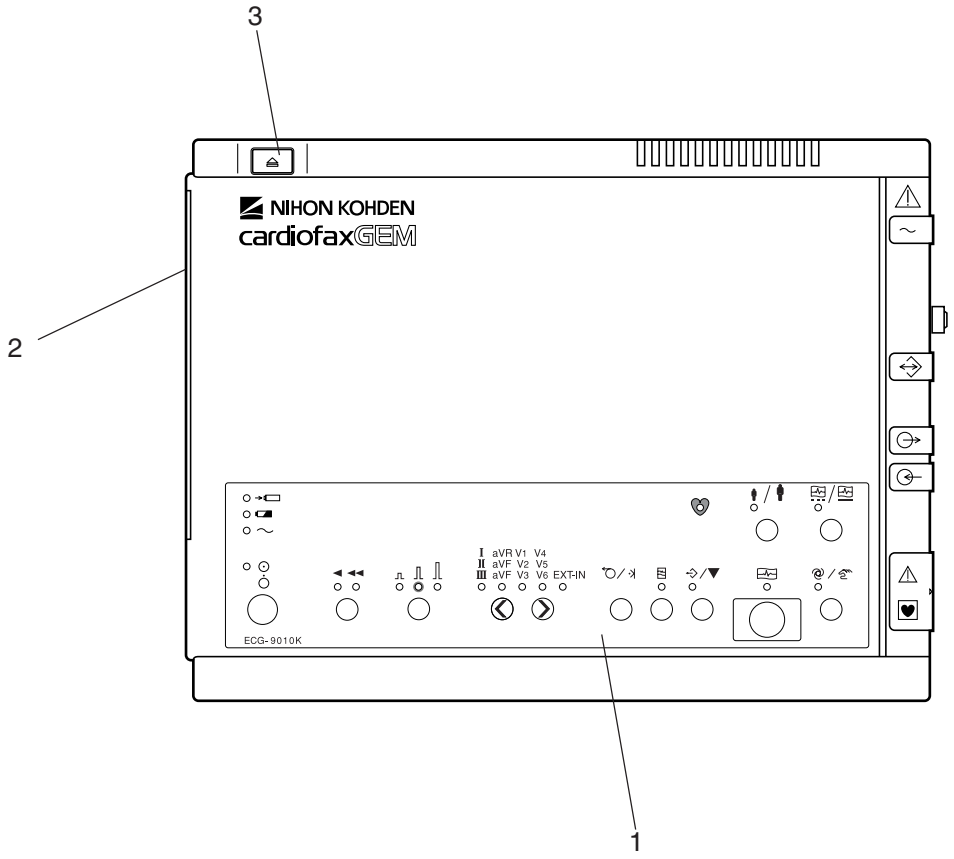
Performance

Performance standard: IEC 60601-2-51 (2003)

Panel Description

ECG-9010K
Electrocardiograph

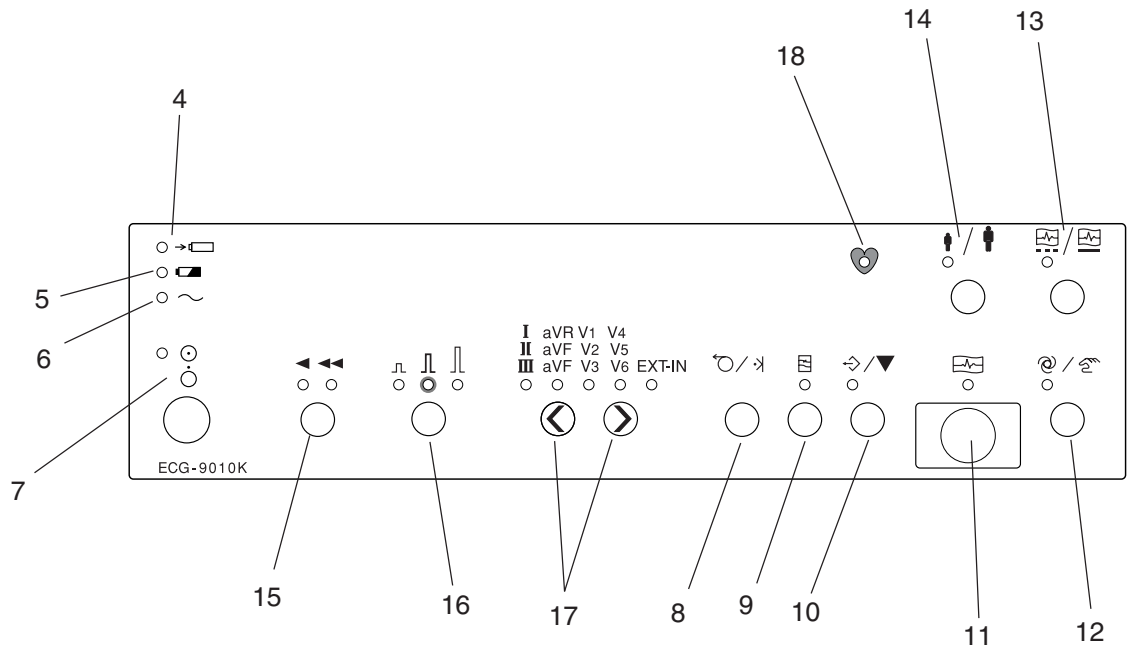
Top View



Name

1. Operation panel
2. Magazine (recording paper container)
3. Magazine release button

Operation Panel

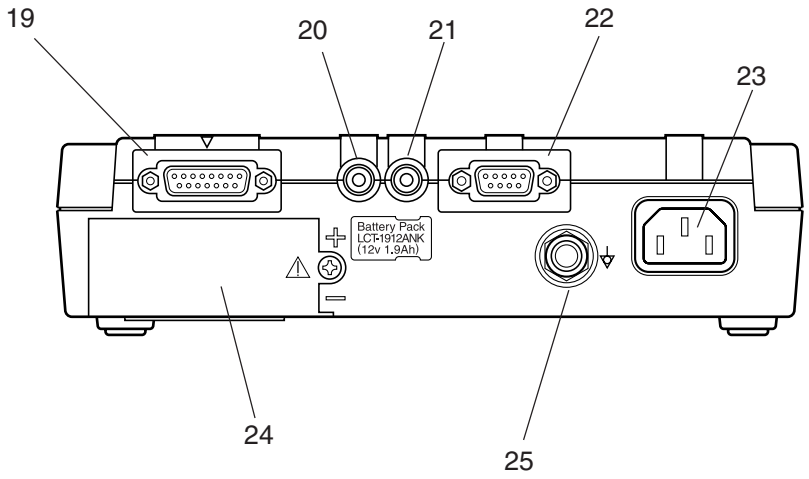


Name

4. Battery charge lamp
5. Battery operation lamp
6. AC power lamp
7. POWER key/lamp
8. FEED/MARK key
9. FILTER key/lamp
10. COPY/CAL key/lamp
11. START/STOP key/lamp
12. AUTO/MANUAL key/lamp
13. REST/PERIODIC key/lamp
14. AGE key/lamp
15. SPEED key/lamp
16. GAIN key/lamp
17. LEAD keys/lamp
18. QRS sync lamp

Right Side Panel

For the ⚠ mark, refer to the descriptions for the Right Side Panel in Section 1 “Panel Descriptions” of the ECG-9010K Operator’s Manual.

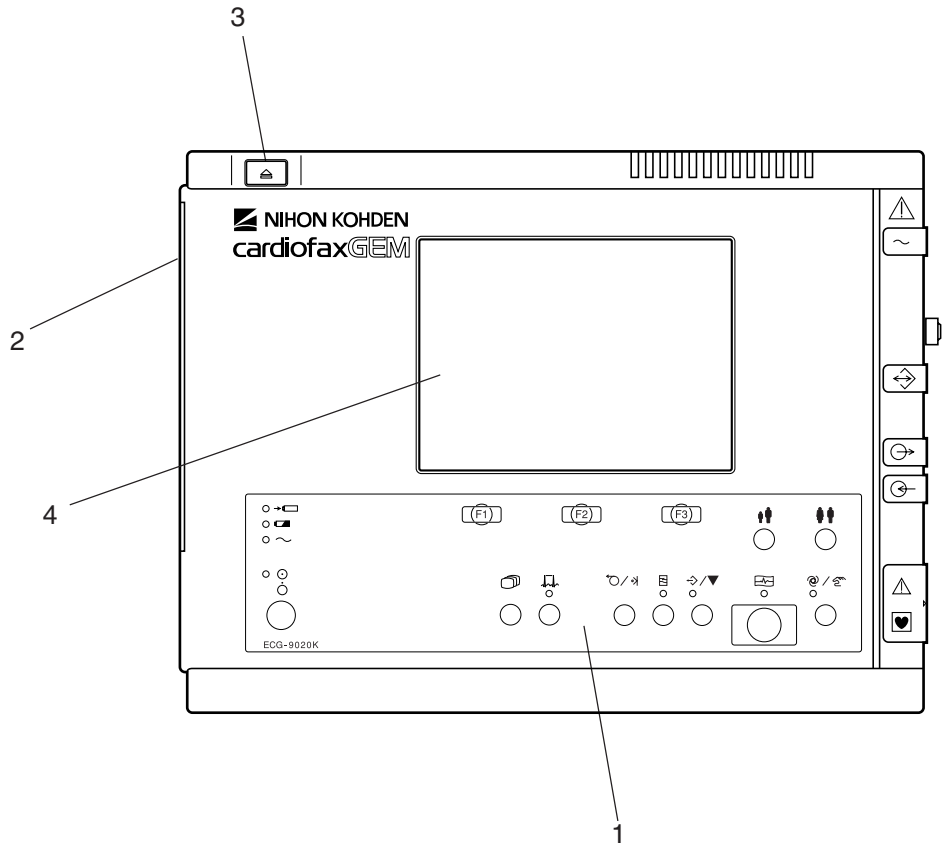


Name

19. Patient input connector
20. EXT-IN connector
21. CRO-OUT
22. SIO connector
23. AC power cord socket
24. Battery compartment
25. Equipotential ground terminal

ECG-9020K/P Electrocardiograph

Top View

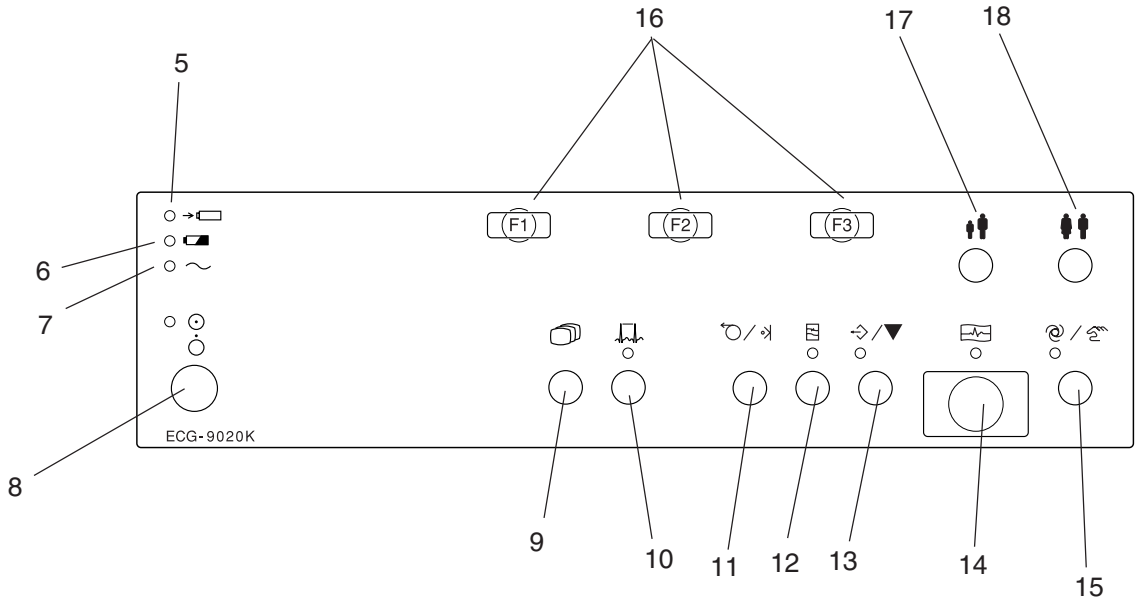


Name

1. Operation panel
2. Magazine (recording paper container)
3. Magazine release button
4. LCD screen

The keyswithes on the ECG-9020P have a name label instead of the symbol.

Operation Panel

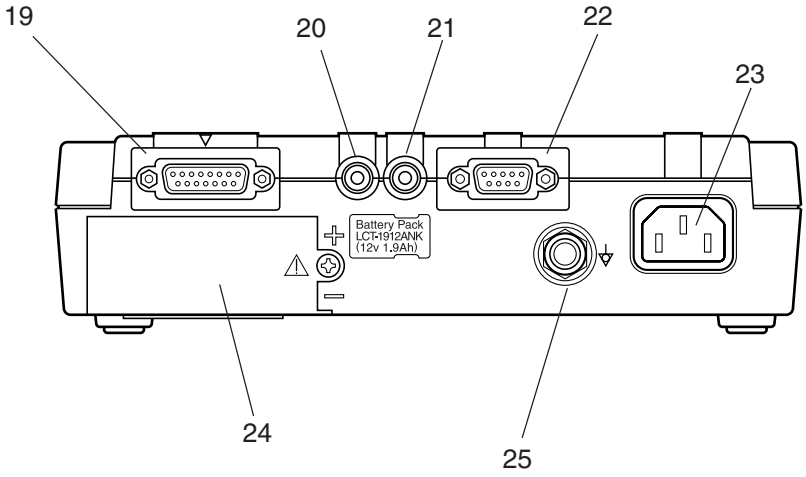


Name

5. Battery charge lamp
6. Battery operation lamp
7. AC power lamp
8. POWER key/lamp
9. MODE key
10 RHYTHM key/lamp
11. FEED/MARK key
12. FILTER key/lamp
13. COPY/CAL key/lamp
14. START/STOP key/lamp
15. AUTO/MANUAL key/lamp
16. F1, F2, F3 function keys
17. AGE key
18. SEX key

Right Side Panel

For the ⚠ mark, refer to the descriptions for the Right Side Panel in Section 1 “Panel Descriptions” of the ECG-9020K or ECG 9020P Operator’s Manual.

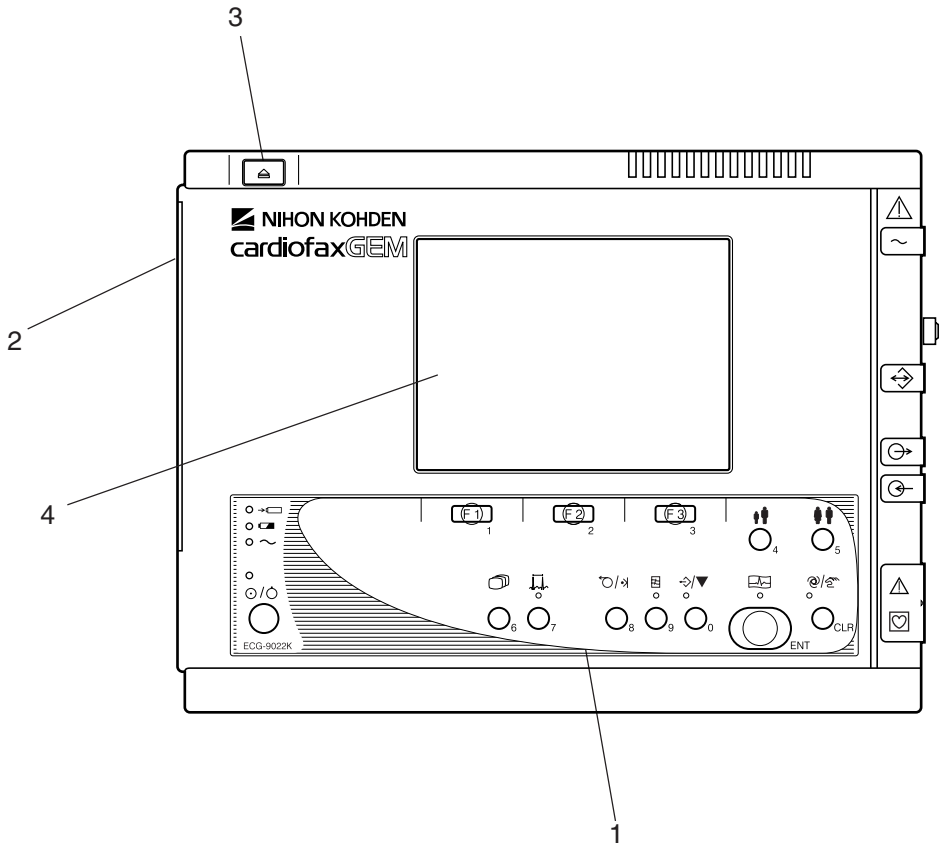


Name

19. Patient input connector
20. EXT-IN connector
21. CRO-OUT
22. SIO connector
23. AC power cord socket
24. Battery compartment
25. Equipotential ground terminal

ECG-9022K
Electrocardiograph

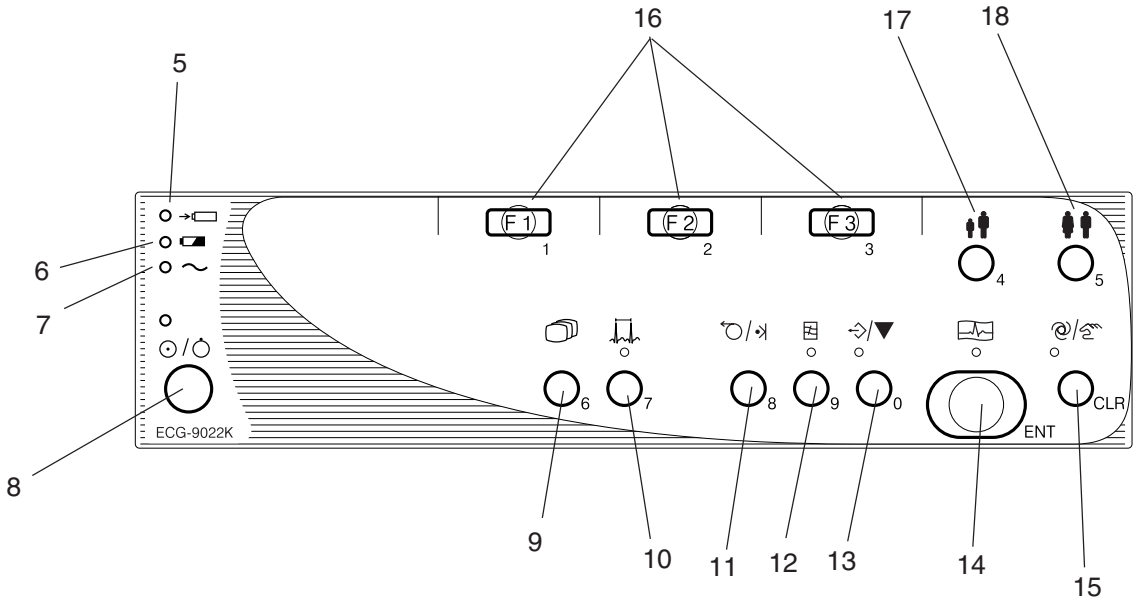
Top View



Name

1. Operation panel
2. Magazine (recording paper container)
3. Magazine release button
4. LCD screen

Operation Panel

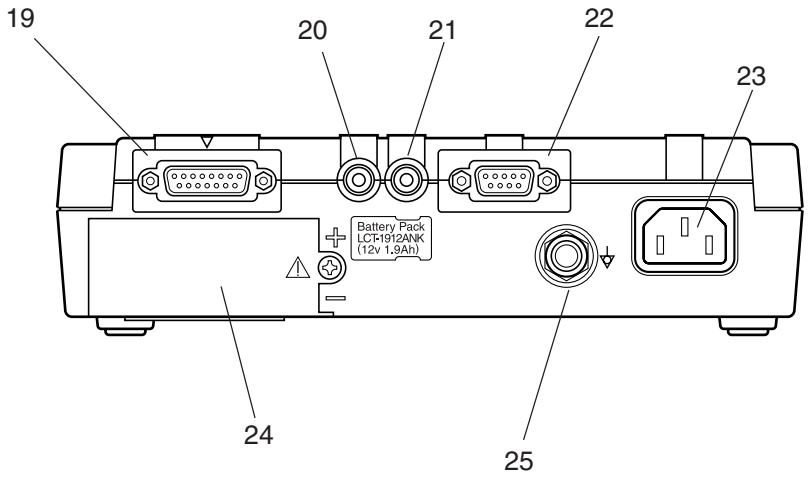


Name

5. Battery charge lamp
6. Battery operation lamp
7. AC power lamp
8. POWER key/lamp
9. MODE key
10 RHYTHM key/lamp
11. FEED/MARK key
12. FILTER key/lamp
13. COPY/CAL key/lamp
14. START/STOP key/lamp
15. AUTO/MANUAL key/lamp
16. F1, F2, F3 function keys
17. AGE key
18. SEX key

Right Side Panel

For the ⚠ mark, refer to the descriptions for the Right Side Panel in Section 1 "Panel Descriptions" of the ECG-9022K Operator's Manual.

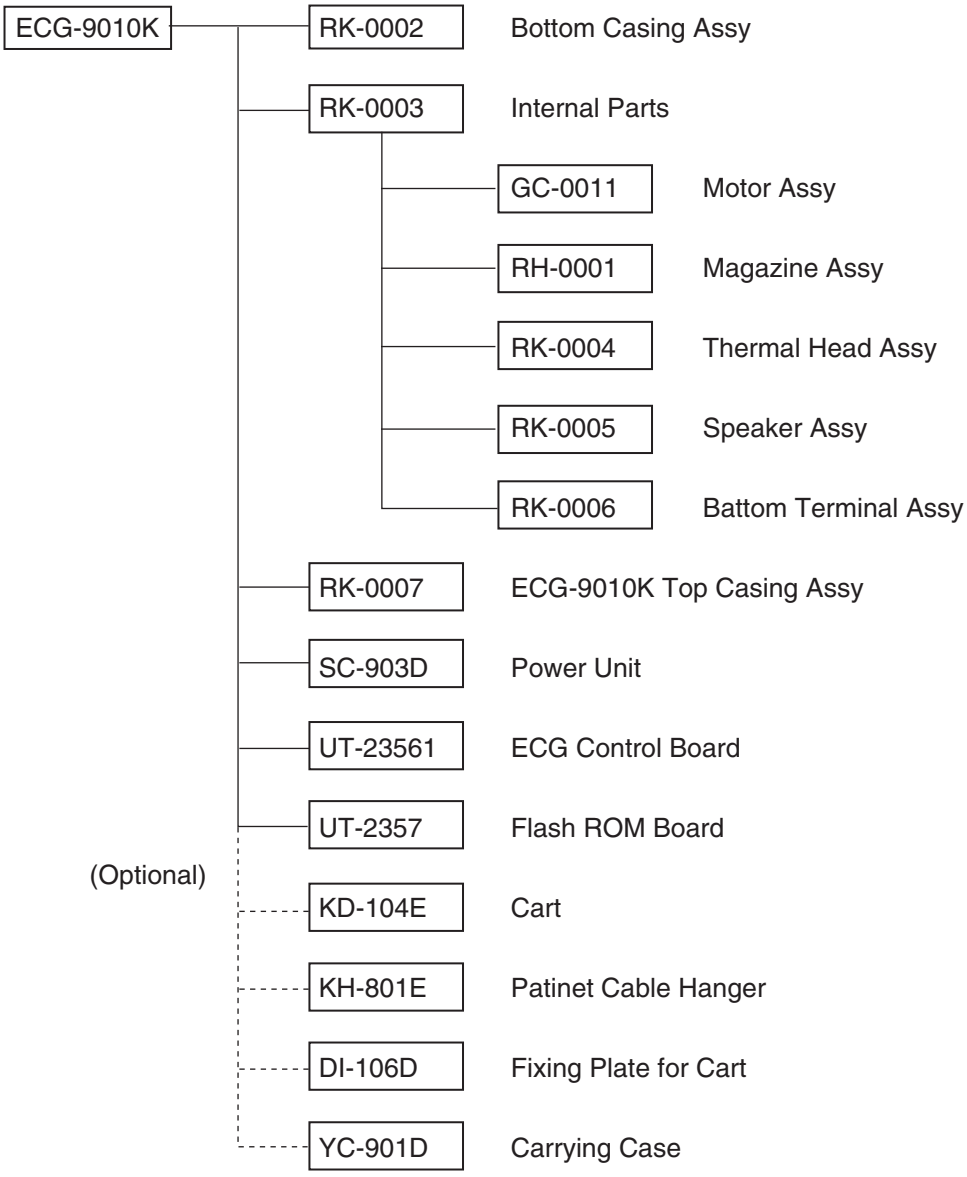


Name

19. Patient input connector
20. EXT-IN connector
21. CRO-OUT
22. SIO connector
23. AC power cord socket
24. Battery compartment
25. Equipotential ground terminal

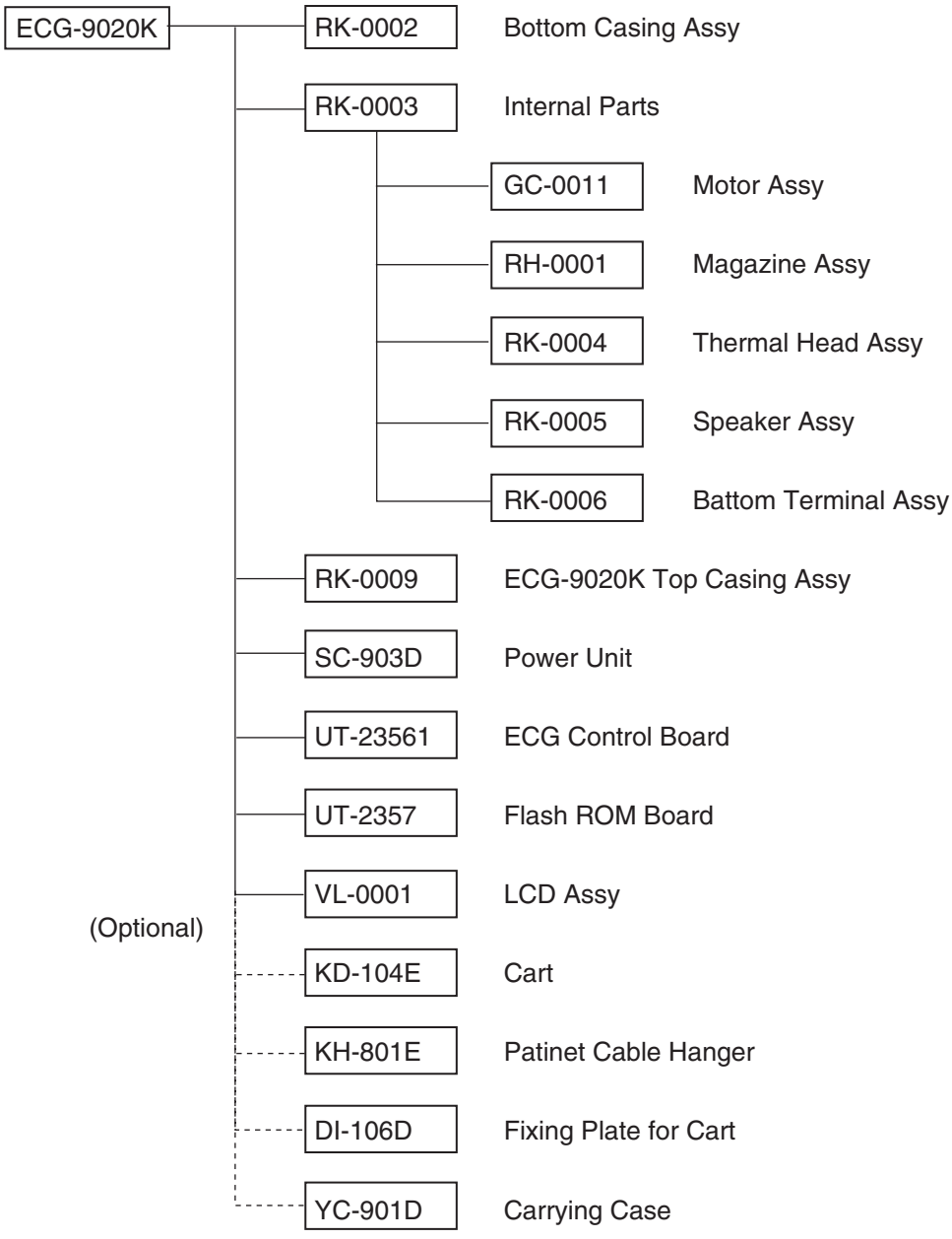
Composition

ECG-9010K Electrocardiograph



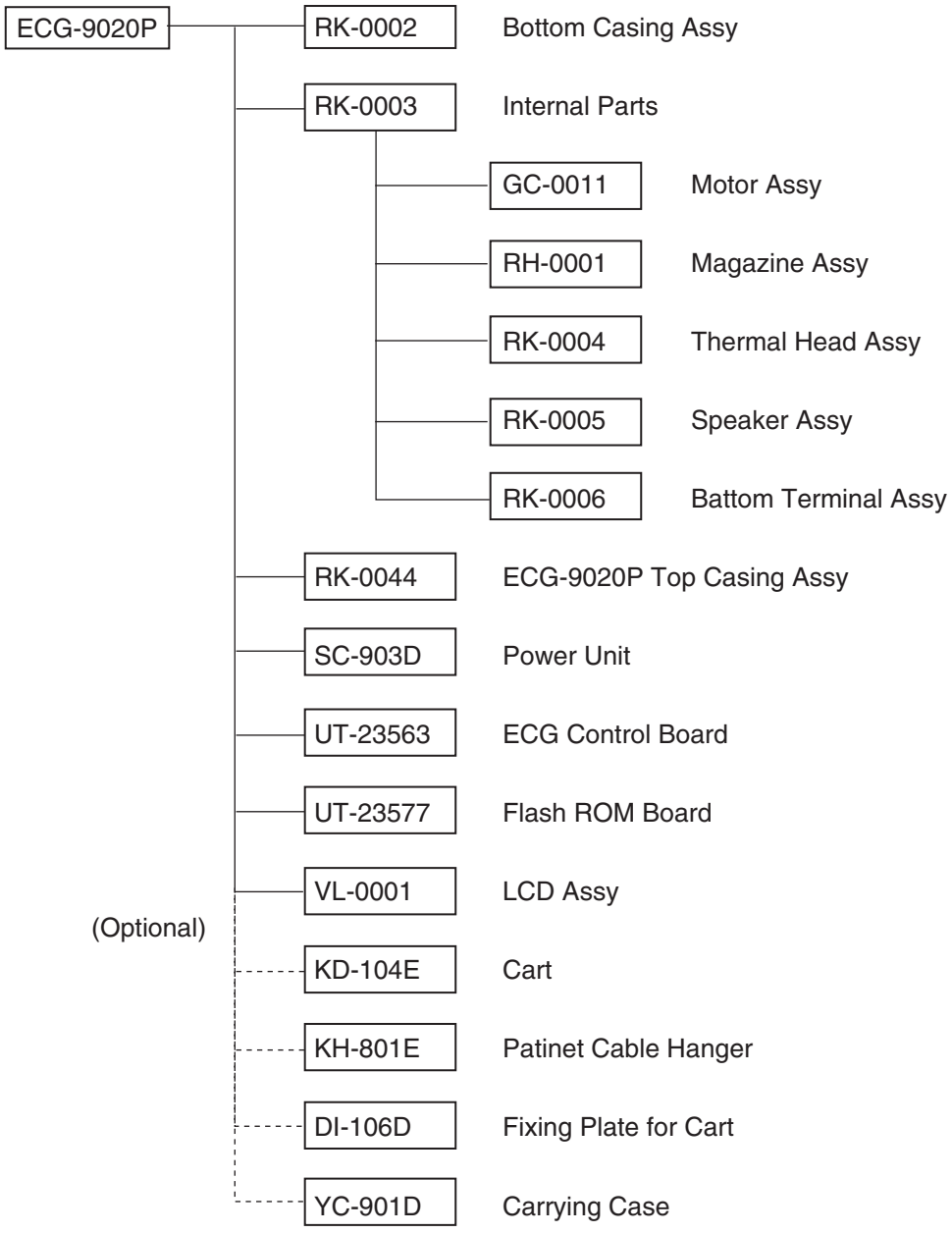
- To order a replacement assembly above, use the Code No.
- To order a replacement component inside an assembly, refer to “Section 7 Replaceablet Parts List”.

ECG-9020K Electrocardiograph



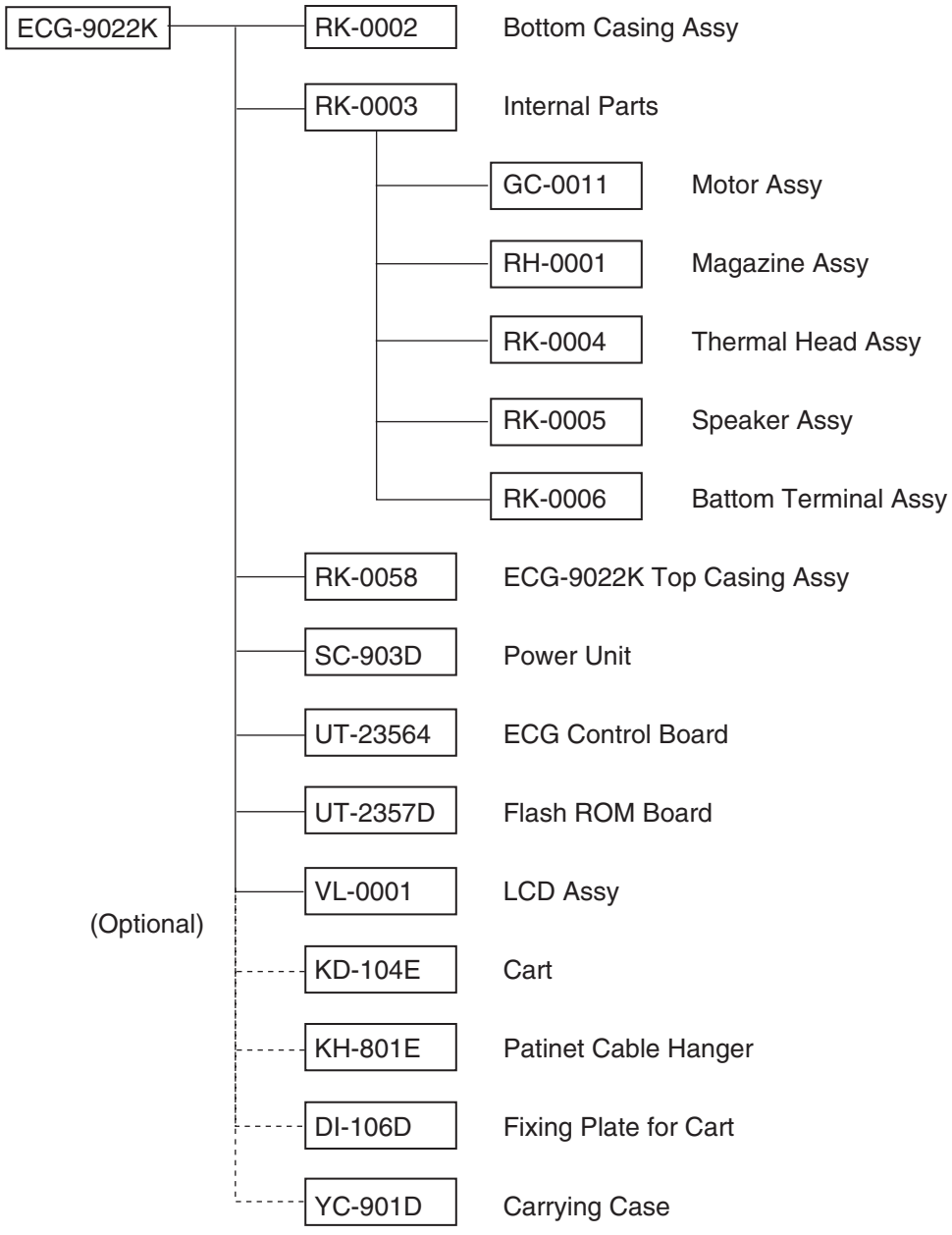
- To order a replacement assembly above, use the Code No.
- To order a replacement component inside an assembly, refer to “Section 7 Replaceablet Parts List”.

ECG-9020P Electrocardiograph



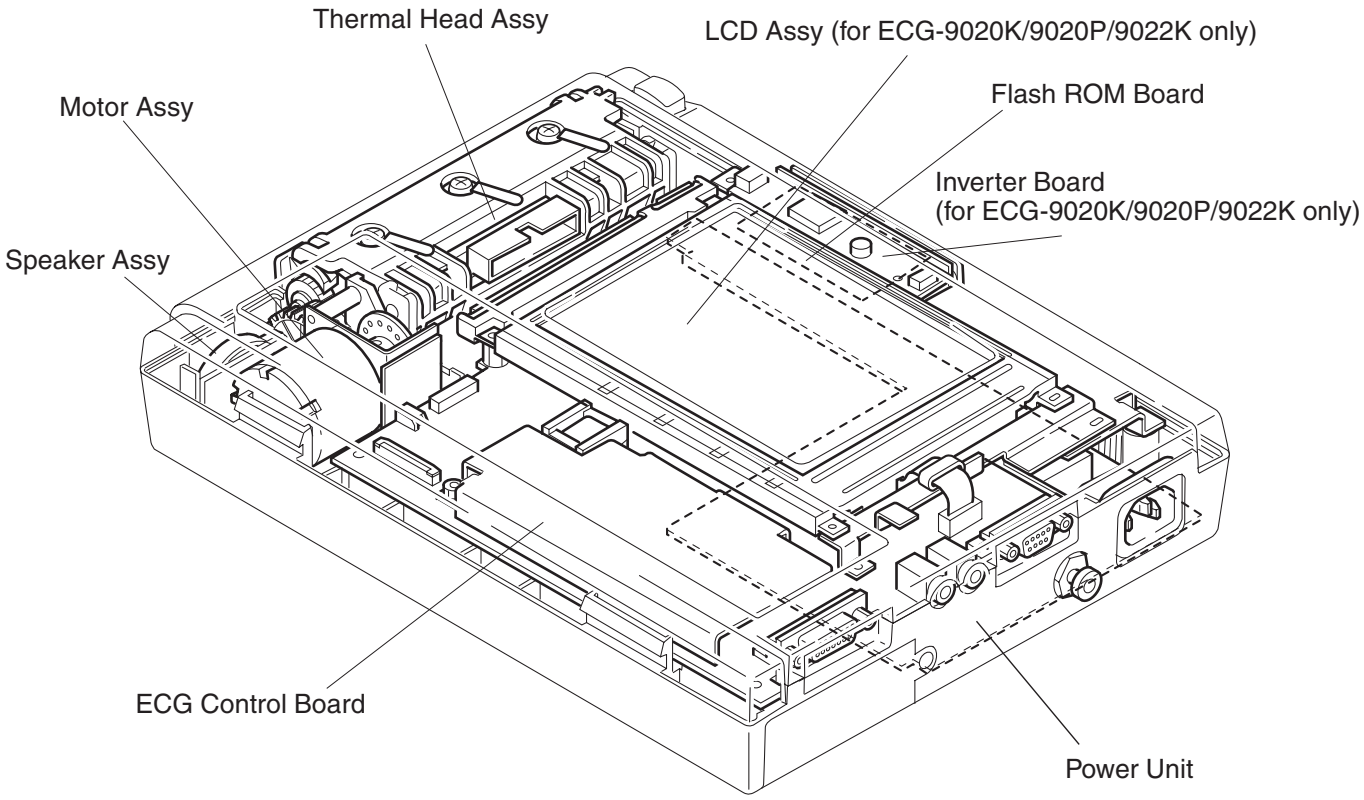
- To order a replacement assembly above, use the Code No.
- To order a replacement component inside an assembly, refer to “Section 7 Replaceablet Parts List”.

ECG-9022K Electrocardiograph



- To order a replacement assembly above, use the Code No.
- To order a replacement component inside an assembly, refer to “Section 7 Replaceablet Parts List”.

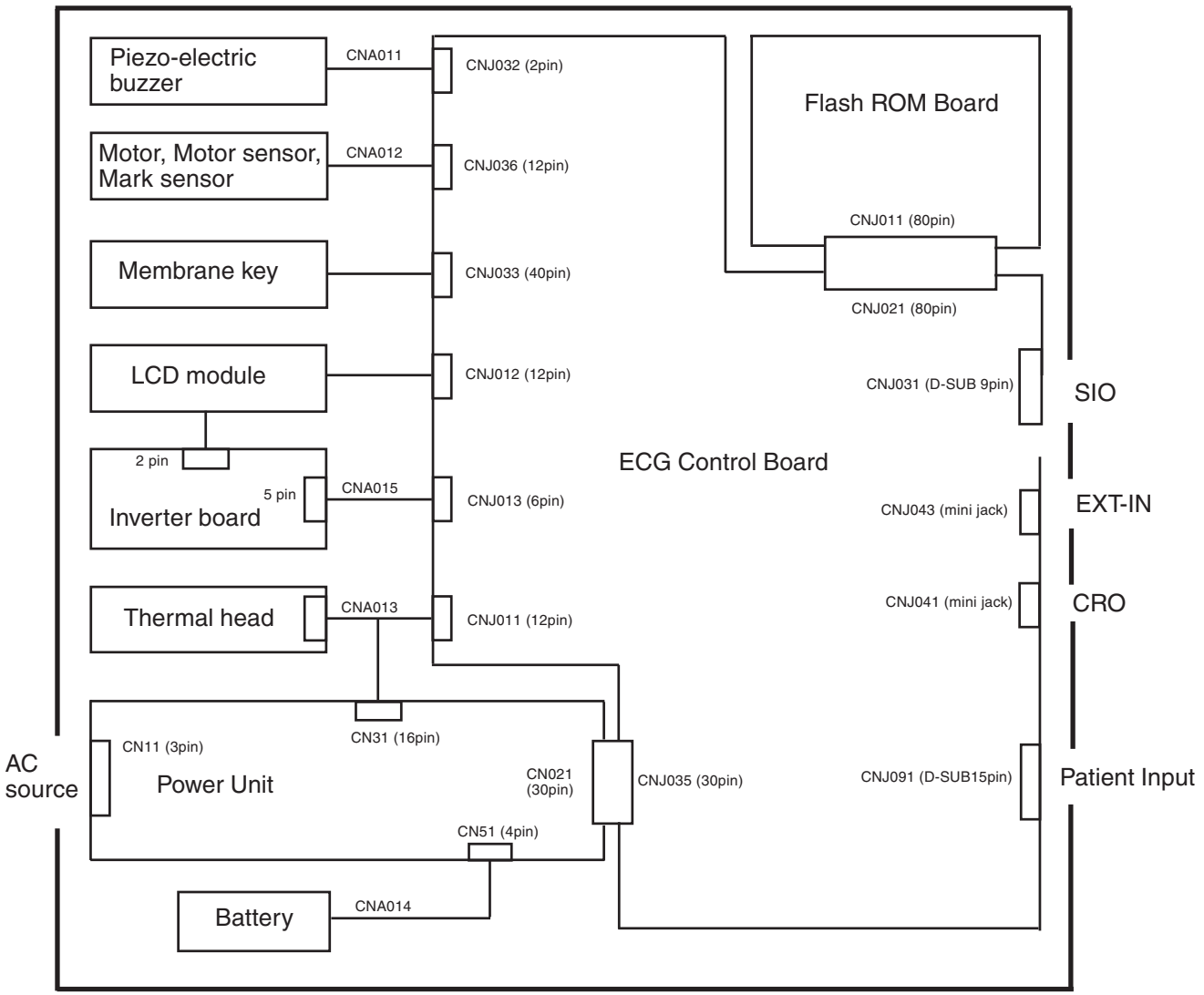
Location


Thermal Head Assy
LCD Assy (for ECG-9020K/9020P/9022K only)
Motor Assy
Flash ROM Board
Inverter Board
(for ECG-9020K/9020P/9022K only)
Speaker Assy
ECG Control Board
Power Unit

Block Diagram

NOTE

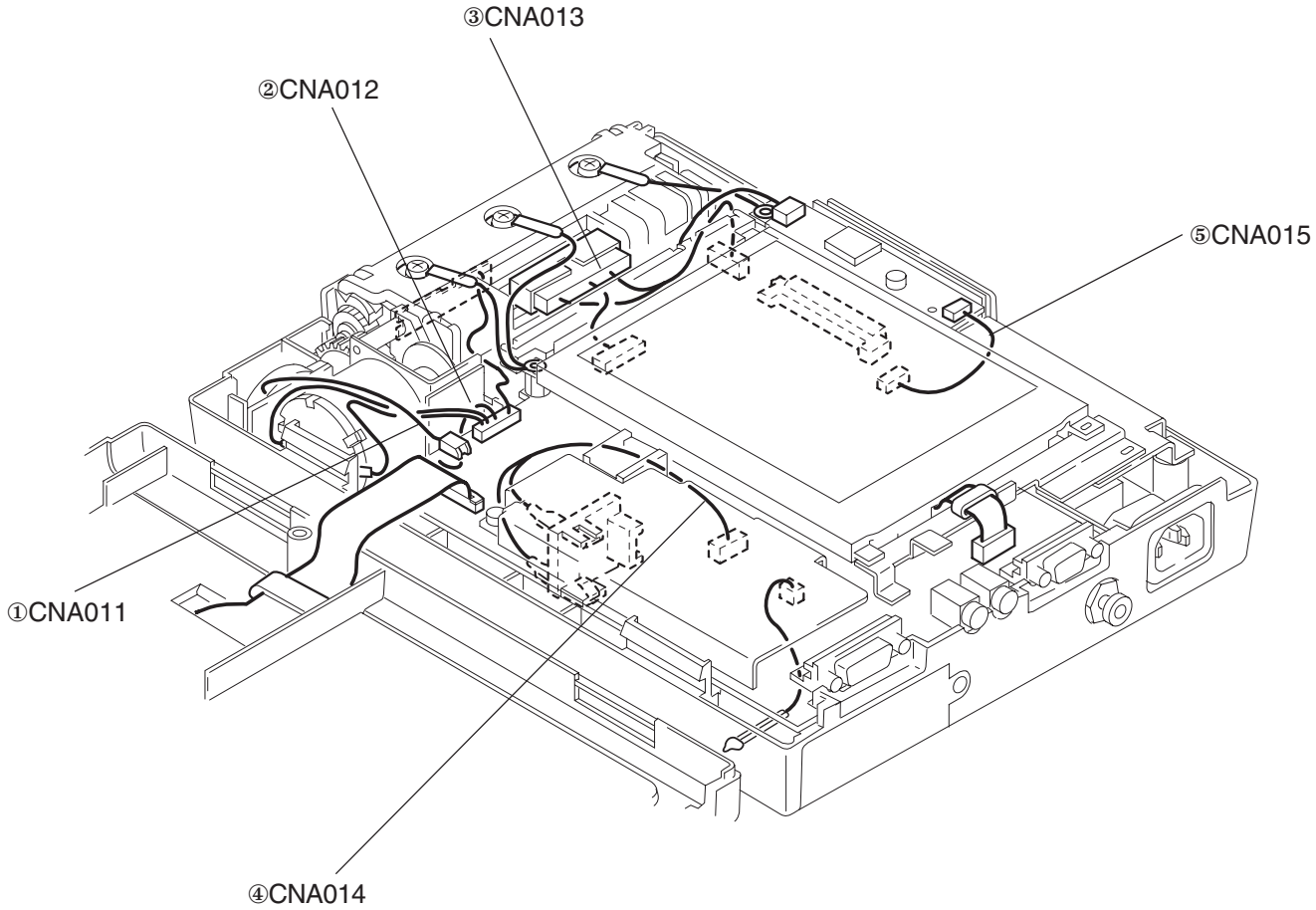
The LCD module and inverter board are used for the ECG-9020K, ECG-9020P and ECG-9022K only.



Connection Diagram

Index	Connector No.	NK Code No.	Description
1*	CNA011	543993A	ZHR-2 speaker cable (L50)
2	CNA012	544002A	ZHR-12 motor cable (L120, 65)
3	CNA013	544029B	FCN723/DF11(100)/51021(40)
4	CNA014	544011A	EHR-4 battery terminal cable (L150)
5	CNA015	544038A	51021-0500/51021-0600 (L50)

* We cannot provide this cable seperately; we can only provide it as part of a complete Speaker assy. Refer to "Speaker Assy" in Section 8.



Section 2 Maintenance

Replacement 2.1
Periodic Replacement Schedule 2.1
Cleaning 2.2
Cleaning and Greasing Schedules 2.2
Cleaning the Paper Mark Sensor and Paper Empty Sensor 2.2
Cleaning the Motor Rotation Sensor and
Greasing the Motor Gear and Gear Meshed with Motor Gear 2.3

This section describes the periodic replacement and cleaning of parts which are required to maintain the instrument in good working condition.

Replacement

This subsection only describes replacement schedule for parts that need to be periodically replaced. The actual replacement procedures are described in the section for Disassembly and Assembly. Read the whole “Disassembly and Assembly” section, especially its Warnings and Cautions, before replacing any of the parts described here.

Periodic Replacement Schedule

To maintain the performance of the instrument, the parts listed in the table below must be periodically replaced by qualified service personnel.

Part	NK Code No.	Description	Recommendation
LCT-1912ANK	332543B	Battery	* See below.
KPT-104-8MGF1-NKC	541816	Thermal head	After 30 km of recording
LM32019T	545946	LCD Module	After 10000 hours
Motor ASSY	GC-0011	Motor ASSY	After 1000 hours
BR2032/1F2	390765	Lithium battery	** See below.

* Replace the battery when it cannot last for 30 minutes during battery operation at the temperatures between 20 and30°C.

** Replace the lithium battery on the ECG control board when the No. 08 or 09 system error message appears or after the lithium battery is used for 7 years. The life time of the battery is approx. 7 years.

Cleaning and Greasing

This subsection describes the cleaning and greasing procedures for parts that must be cleaned and greased by qualified service personnel. The cleaning procedures for parts that can be cleaned by the user are described in the Operator's Manual.

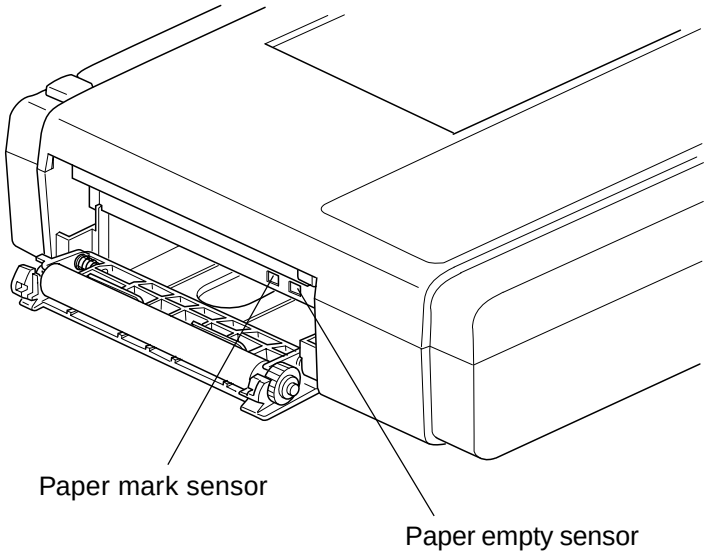
Cleaning and Greasing Schedules

To maintain the performance of the instrument, the parts listed in the table below must be regularly cleaned or greased.

Part	Frequency	Performed by
Instrument (external)	After each use	User
Thermal Head	Once a month	User
Platen Roller assy	Once a year	User
Paper Mark Detection Sensor	Once a month	Qualified service personnel
Paper Empty Sensor	Once a month	Qualified service personnel
Motor Sensor	Once a year	Qualified service personnel
Motor Gear and Gear Meshed with Motor Gear	Once a year	Qualified service personnel

Cleaning the Paper Mark Sensor and Paper Empty Sensor

1. Remove the magazine. The illustration below shows the location of the paper mark sensor and paper empty sensor.
2. Use a piece of cotton moistened with alcohol to clean both sensors.

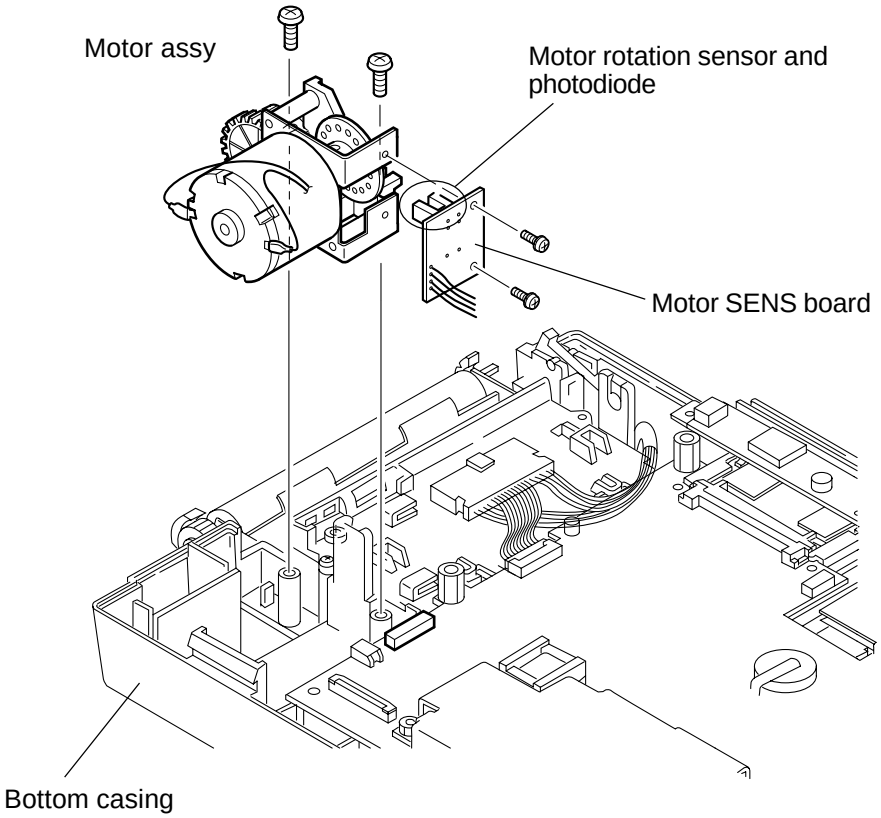


Cleaning the Motor Rotation Sensor and Greasing the Motor Gear and Gear Meshed with Motor Gear

1. Detach the top casing from the bottom casing as described in the “Disassembly and Assembly” section.

2. Remove the two screws holding the motor assy to the bottom casing and remove the motor assy.

3. Remove the two screws to expose the motor rotation sensor and photodiode.

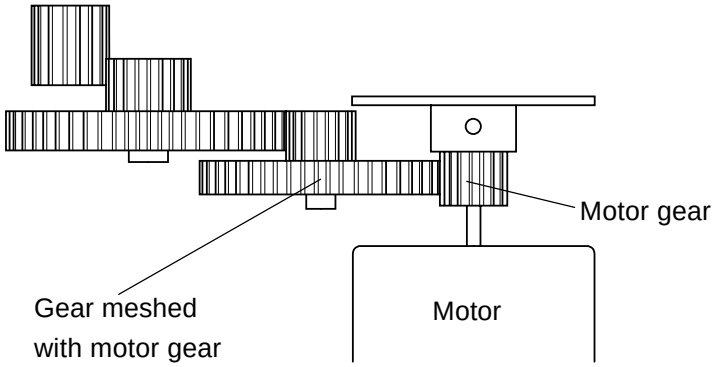


4. Use a piece of cotton moistened with alcohol to clean the sensor and photodiode.

5. Use a brush to clean the holes in the gear.

6. Use EM-50L (NK code No. 547712) grease to grease the motor gear and the gear which directly meshes with the motor gear as shown below.

Top view



7. Reattach the MOTOR SENS board to the motor with the two screws.

8. Reattach the motor assy to the bottom casing with the two screws.

9. Reattach the top casing to the bottom casing as described in the “Disassembly and Assembly” section.

Section 3 Troubleshooting and System Error Message

Troubleshooting Flowchart 3.1
Troubleshooting Table 3.4
    Troubleshooting General Operation Problem 3.4
    Troubleshooting Recording Problem 3.6
System Error Message 3.7

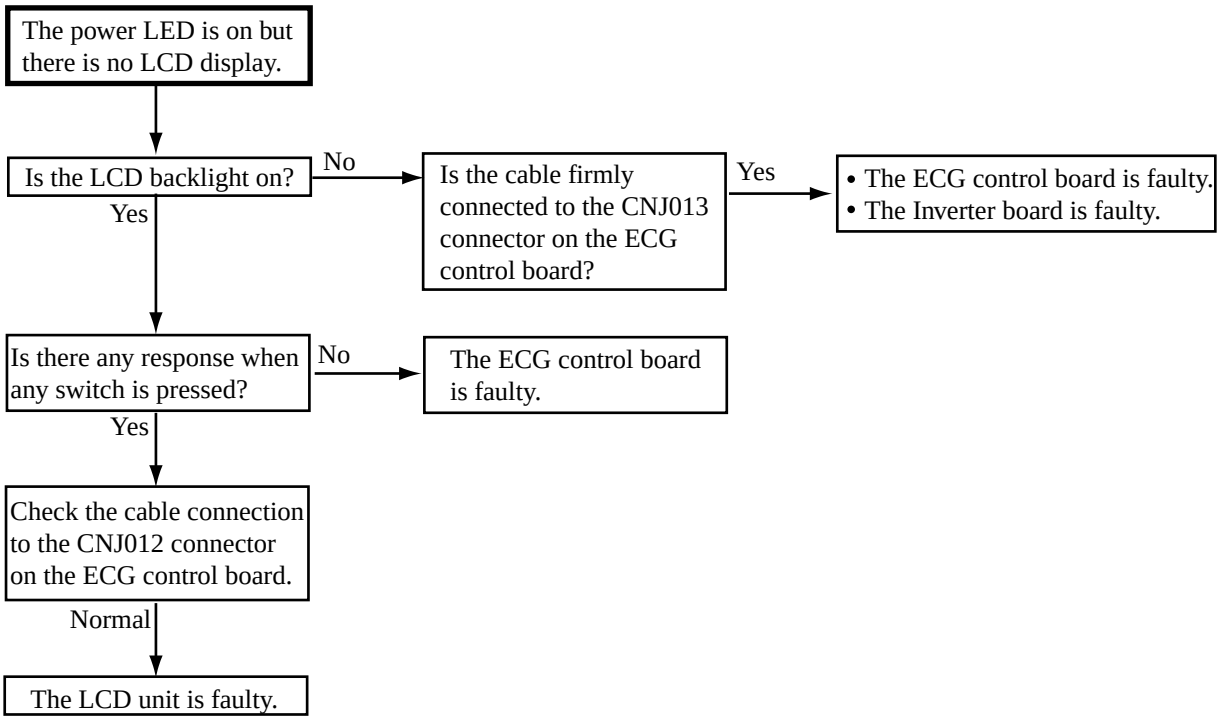
This section describes how to troubleshoot the instrument, using the following:
- flowchart
- troubleshooting table
- system error messages at power-up

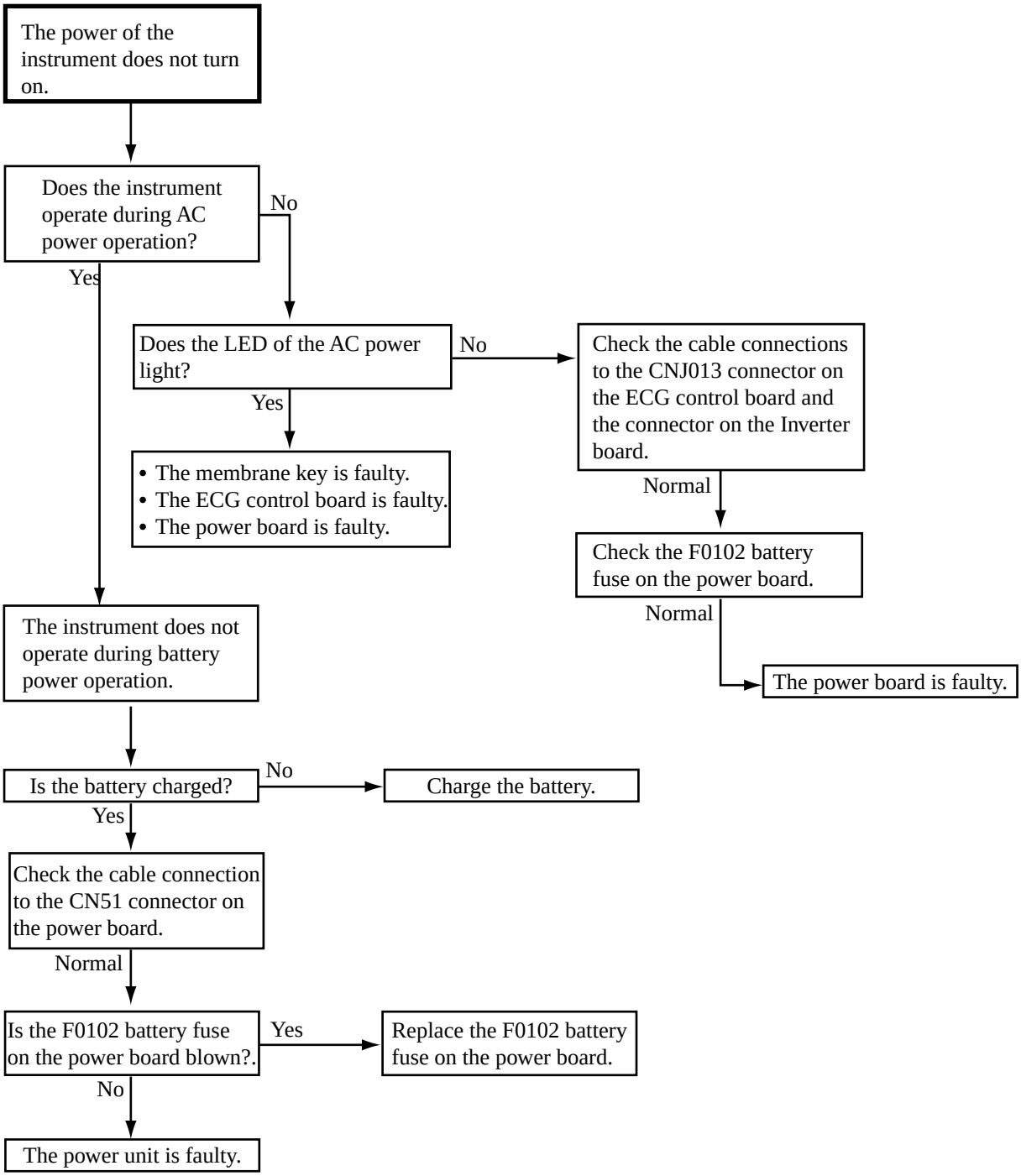
Troubleshooting Flowchart

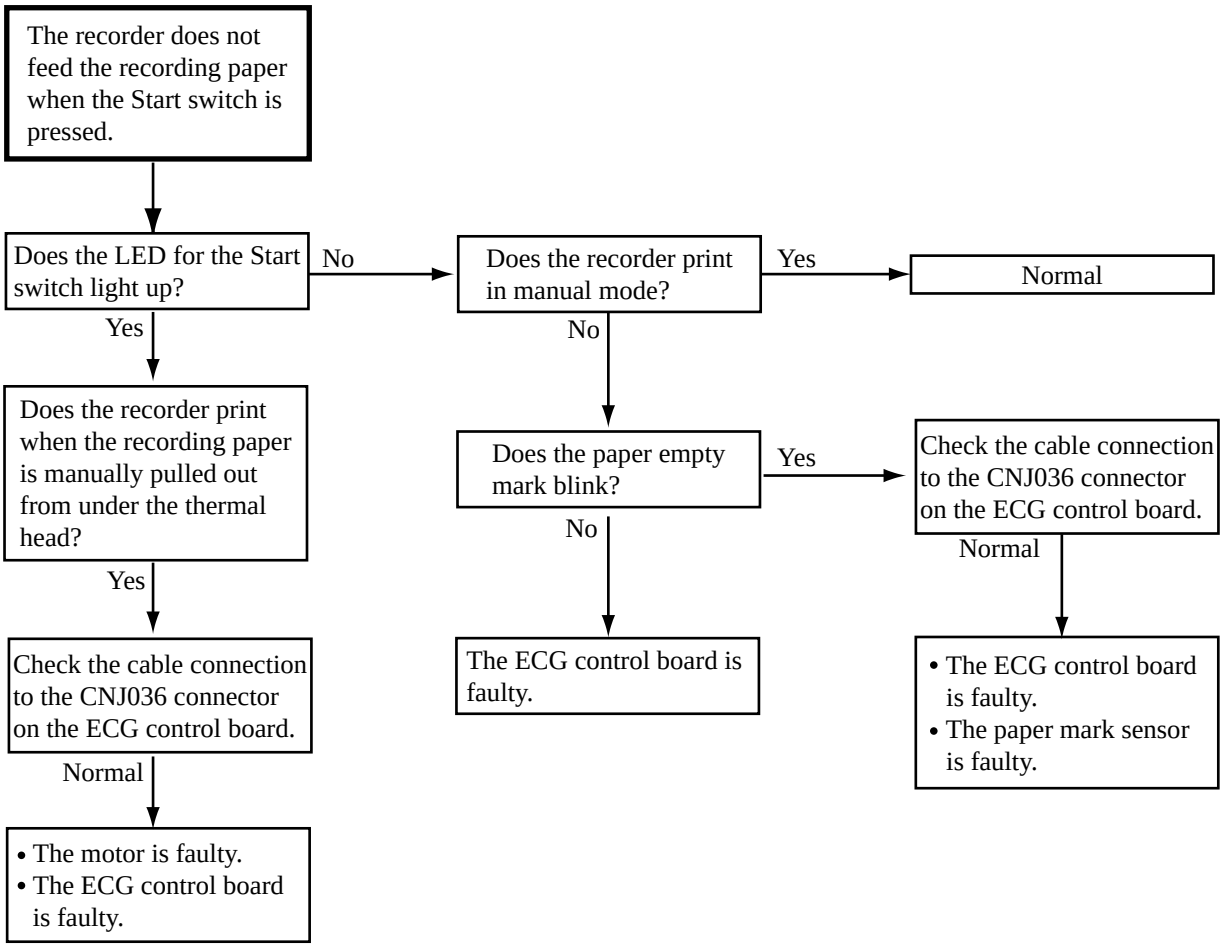
Use the troubleshooting flowchart to find the possible sources of a problem.

Troubleshooting Flowchart

<ECG-9020K only>


The power LED is on but there is no LCD display.
Is the LCD backlight on?
No
Is the cable firmly connected to the CNJ013 connector on the ECG control board?
Yes
• The ECG control board is faulty.
• The Inverter board is faulty.
Yes
Is there any response when any switch is pressed?
No
The ECG control board is faulty.
Yes
Check the cable connection to the CNJ012 connector on the ECG control board.
Normal
The LCD unit is faulty.


The power of the instrument does not turn on.
Does the instrument operate during AC power operation?
No
Yes
Does the LED of the AC power light?
No
Yes
Check the cable connections to the CNJ013 connector on the ECG control board and the connector on the Inverter board.
• The membrane key is faulty.
• The ECG control board is faulty.
• The power board is faulty.
Normal
Check the F0102 battery fuse on the power board.
Normal
The power board is faulty.
The instrument does not operate during battery power operation.
Is the battery charged?
No
Charge the battery.
Yes
Check the cable connection to the CN51 connector on the power board.
Normal
Is the F0102 battery fuse on the power board blown?.
Yes
Replace the F0102 battery fuse on the power board.
No
The power unit is faulty.


The recorder does not feed the recording paper when the Start switch is pressed.
Does the LED for the Start switch light up?
No
Yes
Does the recorder print in manual mode?
Yes
Normal
No
Does the recorder print when the recording paper is manually pulled out from under the thermal head?
Yes
Does the paper empty mark blink?
Yes
Check the cable connection to the CNJ036 connector on the ECG control board.
No
Normal
Check the cable connection to the CNJ036 connector on the ECG control board.
Normal
The ECG control board is faulty.
• The ECG control board is faulty.
• The paper mark sensor is faulty.
• The motor is faulty.
• The ECG control board is faulty.

Troubleshooting Table

Use the troubleshooting table to locate, identify and solve a problem in the instrument. The problems are divided into general operation and recording. Each category has its own troubleshooting table for fast and easy troubleshooting.

How to use the troubleshooting table

1. Determine which troubleshooting table to use.
2. In the "Problem" column find the trouble item that matches the problem.
3. Do the action recommended in the "Corrective Action" column.
4. If the problem is not solved, do the action for the next possible cause or criteria.
5. If none of the actions solve the problem, contact your nearest Nihon Kohden dealer.

Troubleshooting General Operation Problem

Problem	Possible Cause/Criteria	Action
The power LED lights but there is no display or backlight on the LCD screen.	Faulty connection to the CN012 or CNJ013 connector on the ECG control board.	Check the connection to the CNJ012 and CNJ013 connector on the ECG control board.
	Faulty Inverter board.	Replace the Inverter board.
	Faulty LCD module.	Replace the LCD module.
The instrument does not operate during AC power operation.	Blown F011 or F012 power unit fuse.	Replace the F011 or F012 power unit fuse.
	Faulty connection to the CN033 or CNJ035 connector on the ECG control board.	Check the connection to the CNJ033 and CNJ035 connector on the ECG control board.
	Damaged power cord.	Replace the power cord.
	Faulty power unit.	Replace the power unit.
	Faulty ECG control board.	Replace the ECG control board.
	Damaged membrane key.	Replace the membrane key.
The instrument does not operate on battery power.	The battery is not charged.	Charge the battery.
	Blown F051 battery fuse.	Replace the F051 battery fuse.
	Damaged battery.	Replace the battery.
	Faulty connection to the CNJ033 or CNJ035 connector on the ECG control board or the CN031 or CN051 connector on the power unit.	Check the connection to the CNJ033 and CNJ035 connector on the ECG control board and the CN031 and CN01 connector on the power unit.

Problem	Possible Cause/Criteria	Action
No key or switch operation.	Damaged membrane key.	Replace the membrane key.
	Faulty connection to the CNJ033 connector on the ECG control board.	Check the connection to the CNJ033 connector on the ECG control board.
	Faulty ECG control board.	Replace the ECG control board.
Only certain electrode lead waveforms are displayed on the screen or noise appears on the waveform.	The electrodes or cables connections from the patient to the instrument is not properly connected.	Make sure that al electrodes and cables connection from the patient to the instrument are properly connected.
	Faulty ECG control board.	Replace the ECG control board.
No electrode lead waveforms are displayed on the screen or noise appears on all waveforms.	Electrodes not attached to the patient.	Make sure that the electrodes are properly attached to the patient.
	Faulty ECG control board.	Replace the ECG control board.
Vertical and horizontal strips appear on the LCD screen at constant intervals.	Faulty connection to the CNJ013 connector on the ECG control board.	Check the connection to the CNJ013 connector on the ECG control board.
	Faulty ECG control board.	Replace the ECG control board.
	Faulty LCD unit.	Replace the LCD unit.
No sound.	Check the connection to the CNJ032 connector on the ECG control board.	Check the connection to the CNJ032 connector on the ECG control board.
	Faulty speaker.	Replace the speaker assy.

Troubleshooting Recording Problem

Problem	Possible Cause/Criteria	Action
The recorder does not feed the recording paper when the Start switch is pressed.	Dirty paper mark sensor.	Clean the paper mark sensor.
	Faulty connection to the CNJ033 or CNJ036 connector on the ECG control board.	Check the connection to theCNJ033 and CNJ0336 connectors on the ECG control board.
	Damaged membrane key.	Replace the membrane key.
	Faulty ECG control board.	Replace the ECG control board.
	Faulty motor.	Replace the motor.
The recording paper is fed but there is no printing.	The thermal head is incorrectly positioned.	Readjust the position of the thermal head.
	Faulty connection to the CNJ011 connector on the ECG control board or the CN031 connector on the power unit.	Check the connection to the CNJ011 connector on the ECG control board and the CN031 connector on the power unit.
	Faulty thermal head.	Replace the thermal head.
	Faulty power unit.	Replace the power unit.
	Faulty ECG control board.	Replace the ECG control board.
The paper mark cannot be detected.	Dirty paper mark sensor.	Clean the paper mark sensor.
	Faulty connection to the CNJ036 connector on the ECG control board.	Check the connection to the CNJ036 connector on the ECG control board.
	Faulty ECG control board.	Replace the ECG control board.
	Faulty paper mark sensor board.	Replace the paper mark sensor board.
Sometimes the recorder does not print and blank recording paper is fed from the recorder.	The input protection circuit which protects the thermal head from strong noise like hum is rejecting noisy waveforms.	Check the electrode attachment to the patient, and if necessary, re-position the electrodes so that a good ECG waveform is displayed.
The recording paper tracks zigzag or to one side.	Dirty thermal head.	Clean the thermal head.
	The recording paper is not properly set in the instrument.	Make sure that the recordig paper is aligned with the lower recording paper guide
	The thermal head is incorrectly positioned.	Readjust the position of the thermal head.
	Inaccurate or worn out platen roller.	Replace the magazine assy.

System Error Message

During power-up and operation the instrument continuously checks itself for system failure. If a failure is detected, system information and error history are printed on the recording paper and all operations are stopped. System information and error history are also displayed (ECG-9020 only) or printed due to transient noise. After printing the system information and error history, the power of the instrument is automatically turned off.

NOTE

If the same system information appears again after restarting the instrument, do not use the instrument until service personnel has corrected the cause of the problem. Sending a copy of the system information to your nearest Nihon Kohden distributor helps us to troubleshoot your problem quickly.

System Information

Indicates an error number to identify the problem. To solve the problem, do the corrective action described below.

Error No.	Meaning	Corrective Action
"00"	Input unit error: An interrupt signal of 2 ms is generated.	Replace the ECG control board.
"01"	Input unit error: There is no response to the host.	Replace the ECG control board.
"02"	Input unit error: Communication protocol error.	Replace the ECG control board.
"03"	4 bit CPU error: Initialization error.	Replace the ECG control board.
"04"	4 bit CPU error: "No response" error.	Replace the ECG control board.
"05"	A key on the operaton panel is short-circuited.	Replace the membrane key.
"06"	RTC error: No interrupt signal of 125 ms.	Replace the ECG control board.
"07"	RTC error: Incorrect data in SRAM.	Replace the ECG control board.
"08"	All the system setup settings other than the items described in the following note are returned to the factory initial settings. This is because the lithium battery is replaced.	"Error 08" appears once after the lithium battery is replaced. Corrective action is not required.
"09"	Lithium battery is completely discharged.	Replace the lithium battery.
"10"	Bus error.	Replace the ECG control board.
"11"	Address error.	Replace the ECG control board.

Error No.	Meaning	Corrective Action
"12"	Illegal command.	Replace the ECG control board.
"13"	Zero division error.	Replace the ECG control board.
"14"	Power off time out.	Replace the ECG control board.
"15"	EEPROM error: This occurs due to the EEPROM check error, installed language error or communication error between the host and EEPROM.	Replace the ECG control board.
"16"	Local language flash memory error.	Replace the ECG control board.
"17"	ECG model error.	Replace the ECG control board.
"18"	Local language is not installed.	Install the local language.
"19"	Local language is not installed.	Install the local language.
	Error in memory area for local language.	Re-install the local language.
"20"	Local language text file version does not match the ECG software version.	Install the local language text file which is the same version as the ECG software.
"21"	ECG interpretation error (Time over).	Check the input waveforms. If any noise is superimposed on the waveforms, find and eliminate the cause. If no noise is superimposed on the waveform, replace the ECG control board.
"22"	The entered information does not match the data in the flash memory.	Replace the ECG control board.

NOTE

- **"Error 05" also appears when any key on the operation panel is pressed and held down.**
- **When "Error 08" appears, the following settings are not reset to the factory initial settings even if the instrument is initialized.**
  - **display language**
  - **hospital name**
  - **recording resolution setting**
  - **elapsed time**
  - **saved ECG data**
  - **hum filter**
  - **direct/modem connection**
  - **cue mark position**
  - **local language font**

Error History

Indicates the latest three errors and the date of the latest error, as in the example below.

********** System Information **********

Error number:	15
Date:	Apr 20, 1998 10:41 AM
Program:	9020K
Version:	01-00 01-01 01-01

********** Error History **********

No.1 Error number: 15 Apr 20, 1998 10:30 AM
No.2 Error number: 15
No.3 Error number: 15

NIHON KOHDEN Mon Apr 20, 10:41 11 JST 1998

Section 4 System Test, Adjustment, And Setting

System Test 4.1
Overall 4.1
Calling up the Test Level 1 ..... 4.2
Calling up the Test Level 2 ..... 4.3
Entering the System Test Number 4.4
Executing the System Test 4.5
Quitting the System Test 4.6
Exiting the System Test Mode 4.6
Demonstration 4.7
Recorder 4.8
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Key 4.12
Memory 4.13
Single Memory Test Mode 4.14
Continuous Memory Test Mode 4.14
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Calibration 4.18
Communication 4.19
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System Setup Initialization 4.23
ECG Findings List Recording 4.24
Recording Resolution Setting 4.25
Cue Mark Adjustment 4.26
Date and Time Setting 4.28
Setting the Date and Time 4.28

This section describes:

- how to check the operation of the instrument in the System Test mode.
- how to output the ECG findings list in the System Test mode.
- how to initialize the system in the System Test mode.
- how to adjust the thermal head recording resolution and recording paper cutting position in the System Test mode.
- how to set date and time in the System Setup mode.

System Test

Overall

The instrument has two System Test modes: Test level 1 for operator and Test level 2 for qualified service personnel. The test items marked with * perform the same test in Test levels 1 and 2. Each Test level consists of the following system test items:

Test level 1

- Demonstration
- Recorder
- Key*
- Memory*
- LCD/LED*(1)
- Input unit*
- Calibration*
- Communication*
- CRO/EXT1*
- System Setup Initialization*
- ECG Findings List Recording

Test level 2

- Recorder
- Thermal head
- Recording resolution setting
- Key*
- Memory (single)*
- Memory (continuous)
- LCD/LED*(1)
- Input unit*
- Calibration*
- Communication*
- CRO/EXT1*
- System Setup Initialization*
- Cue mark adjustment

(1) LCD is checked for the ECG-9020K only.

NOTE

In the description of some test items in this section, whenever it is appropriate, a description of the source of problem and its corrective action will be described in table form for fast and easy troubleshooting. If none of the actions solve the problem, contact your Nihon Kohden representative.

Calling up the Test Level 1

1. If the power is on, turn it off.

NOTE

Release the FEED/MARK key immediately after the instrument starts printing. If you continue to hold the FEED/MARK key for more than 15 seconds, the instrument recognizes that the FEED/MARK key is short-circuited and prints the system information "Error 05" at the end of printing.

2. Press the POWER key while pressing the FEED/MARK key. Hold the FEED/MARK key until the instrument begins to print the system test procedure, relationship between the input number and its corresponding key name on the operation panel and system test number list as shown below. The Test level 1 is called up and the instrument is in standby mode for entering the system test number. (The System Test screen appears for the ECG-9020K only as shown below.)

   To cancel printing the following information, press the START/STOP key.

   The only difference between the ECG-9010K and ECG-9020K printouts is the description of the key explanation.

Printout (ECG-9020K)

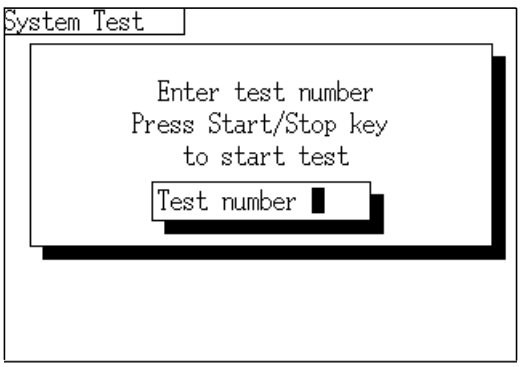
System Test
1:
To check system, press system test number, then press START/STOP key.
2:
To quit the test, press AUTO/MANUAL key.

Key Explanation
0: COPY/CAL
1: F1
2: F2
3: F3
4: AGE
5: SEX
6: MODE
7: RHYTHM
8: FEED/MARK
9: FILTER

Test level 1

Demonstration	[00]
Recorder	[01]
Key	[02]
Memory	[03]
LCD/LED	[04]
Input unit	[05]
Calibration	[06]
Communication	[07]
CRO/EX1	[08]
System Setup Initialization	[10]
ECG Findings List Recording	[11]

Sytem Test Screen (ECG-9020K)



Calling up the Test Level 2

1. If the power is on, turn it off.

NOTE

Release the FEED/MARK key immediately after the instrument starts printing. If you continue to hold the FEED/MARK key for more than 15 seconds, the instrument recognizes that the FEED/MARK key is short-circuited and prints the system information "Error 05" at the end of printing.

2. Press the POWER key while pressing the FEED/MARK and AUTO/MANUAL keys together. Hold the FEED/MARK and AUTO/MANUAL keys until the instrument begins to print the system test procedure, relationship between the input number and its corresponding key name on the operation panel and system test number list as shown below. The Test level 2 is called up and the instrument is in standby mode for entering the system test number. (The System Test screen appears for the ECG-9020K only as shown below.)

   To cancel printing the following information, press the START/STOP key.

   The only difference between the ECG-9010K and ECG-9020K printouts is the description of the key explanation.

Printout (ECG-9020K)

System Test
1:
To check system, press system test number, then press START/STOP key.
2:
To quit the test, press AUTO/MANUAL key.

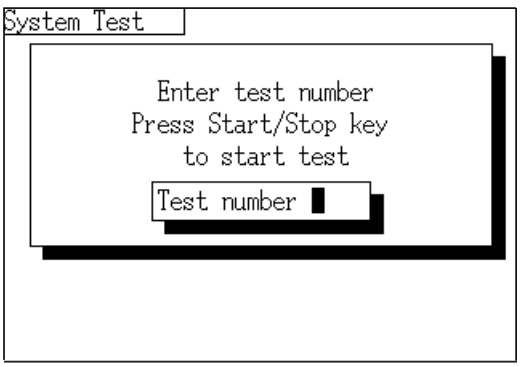
Key Explanation
0: COPY/CAL
1: F1
2: F2
3: F3
4: AGE
5: SEX
6: MODE
7: RHYTHM
8: FEED/MARK
9: FILTER

Test level 2

Recorder	[00]
Thermal head	[01]
Recording resolution setting	[02]
Key	[03]
Memory (single)	[04]
Memory (continuous)	[05]
LCD/LED	[06]
Input unit	[07]
Calibration	[08]
Communication	[09]
CRO/EXT1	[10]
System Setup Initialization	[12]

Cue mark adjustment (–4.0 mm)	[13]
Cue mark adjustment (–3.5 mm)	[14]
Cue mark adjustment (–3.0 mm)	[15]
Cue mark adjustment (–2.5 mm)	[16]
Cue mark adjustment (–2.0 mm)	[17]
Cue mark adjustment (–1.5 mm)	[18]
Cue mark adjustment (–1.0 mm)	[19]
Cue mark adjustment (–0.5 mm)	[20]
Cue mark adjustment (0 mm)	[21]
Cue mark adjustment (–0.5 mm)	[22]
Cue mark adjustment (–1.0 mm)	[23]
Cue mark adjustment (–1.5 mm)	[24]
Cue mark adjustment (–2.0 mm)	[25]
Cue mark adjustment (–2.5 mm)	[26]
Cue mark adjustment (–3.0 mm)	[27]
Cue mark adjustment (–3.5 mm)	[28]
System Setup transfer	[29]
System Setup receiver	[30]
Reset elapsed time	[31]
Download font	[32]

Sytem Test Screen (ECG-9020K)



Entering the System Test Number

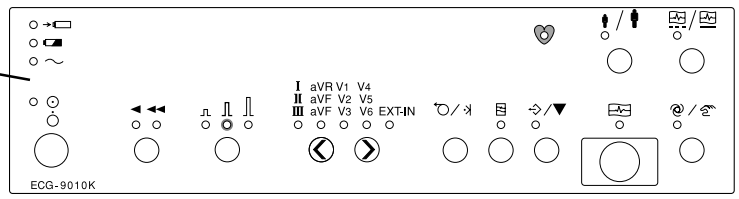
Use the following keys on the operation panel to enter a 2-digit number for executing the desired system test. The specified system test numbers are indicated in the [*xx*] bracket at the right of each system test item on the printout output when the Test level 1 or 2 is called up. Refer to the "Calling up the Test Level X" section.

To delete the entered number, press the AUTO/MANUAL key. To delete a 2-digit number, press the AUTO/MANUAL key twice. At this time, the ones digit number is deleted before the tens digit number is deleted.

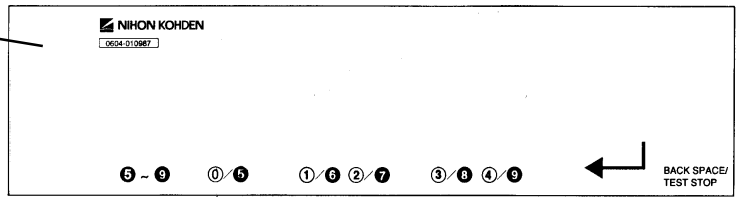
ECG-9010K Keys and Corresponding Number Values

Number	Key	Number	Key
0	GAIN	5	SPEED + GAIN
1	LEAD < (left arrow)	6	SPEED + LEAD < (left arrow)
2	LEAD > (right arrow)	7	SPEED + LEAD > (right arrow)
3	FEED/MARK	8	SPEED + FEED/MARK
4	FILTER	9	SPEED + FILTER

Operation panel



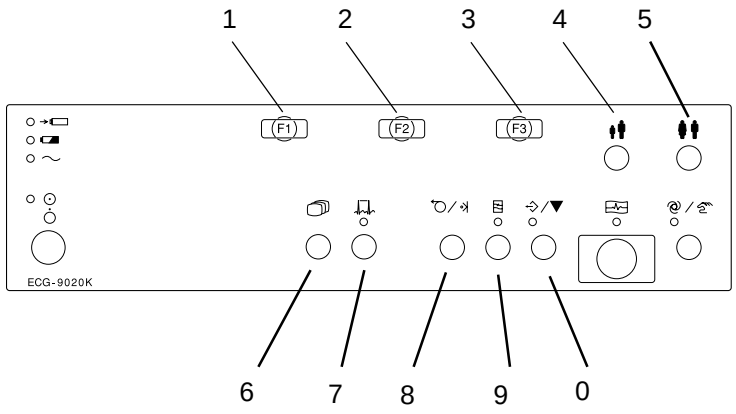
9010 Program sheet



For easy reference, place the provided 9010 Program sheet on the operation panel.

ECG-9020K Keys and Corresponding Number Values

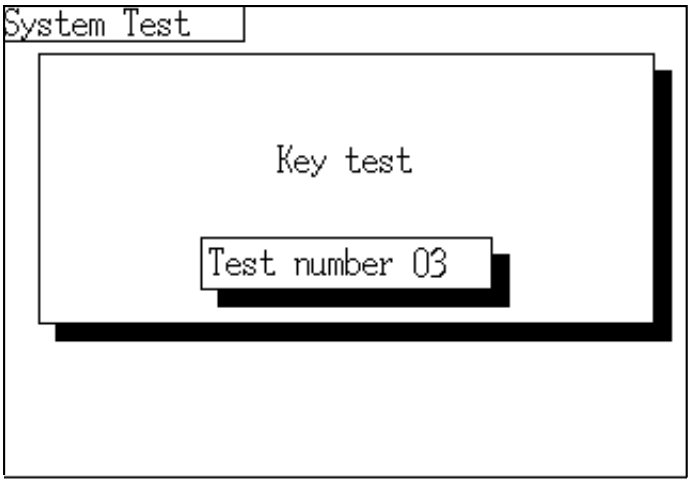
Number	Key	Number	Key
0	COPY/CAL key	5	SEX key
1	F1 function key	6	MODE key
2	F2 function key	7	RHYTHM key
3	F3 function key	8	FEED/MARK key
4	AGE key	9	FILTER key



Executing the System Test

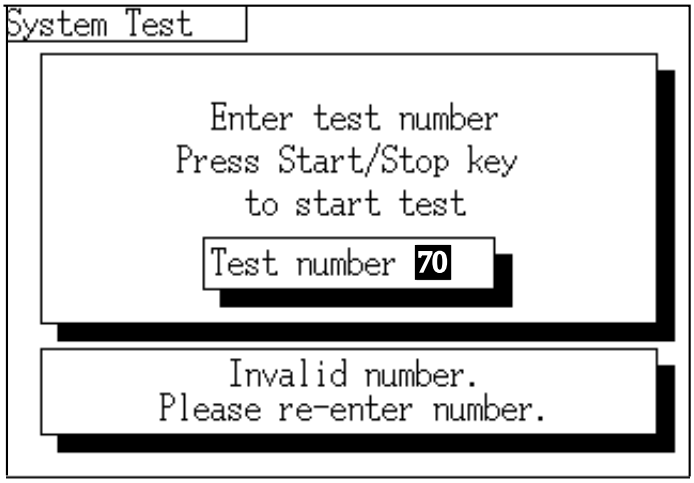
Press the START/STOP key. For some tests, the System Test screen is displayed during the test as shown below (ECG-9020K only).

System Test Screen (ECG-9020K)



If you entered an unspecified number, an alarm occurs. The alarm indication is different between the ECG-9010K and ECG-9020K as follows:

- ECG-9010K: 8 repeating “pips” alarm sound is generated.
- ECG-9020K: 8 repeating “pips” alarm sound and the “Invalid number. Please re-enter number” error message is displayed as shown below.



To re-enter the system test number, do either of the folowing:

- Delete the previously entered number by pressing the AUTO/MANUAL key.
- Enter the system test number by overwriting the previously entered number.

Quitting the System Test

The procedures to quit each system test vary from test to test. Some tests automatically end after an alarm sound is generated or a printout is output. Refer to the following explanations for each test. After quitting each test, the instrument returns to the standby mode for entering the system test number.

After a system test is completed, you can execute other system test without exiting the System Test mode .

Exiting the System Test Mode

After all desired system tests are finished, press the POWER key.

Demonstration

This is used to learn or teach instrument operation.

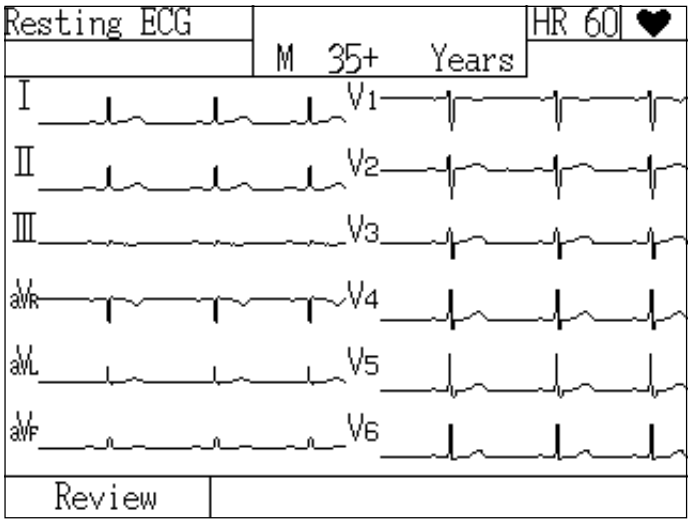
While executing this test item, the instrument generates dummy 12 lead ECG resting waveforms until the power of the instrument is turned off. The ECG waveforms can be recorded and also displayed as shown below (ECG-9020k only).

Procedure

Enter the system test number [00] (Test level 1) and press the START/STOP key.

To quit the test, turn the power of the instrument off by pressing the POWER key.

Dummy 12 lead ECG resting waveforms on LCD



Recorder

This is used to check the condition of the recorder by printing test patterns. The recording test patterns consist of the following and are printed in the following order:

1. Diagonal lines
2. Characters H and X (Test level 1 only)
3. Grid
4. Paper speed scales (10, 12.5, 25 and 50 mm/s)
5. Paper mark detection

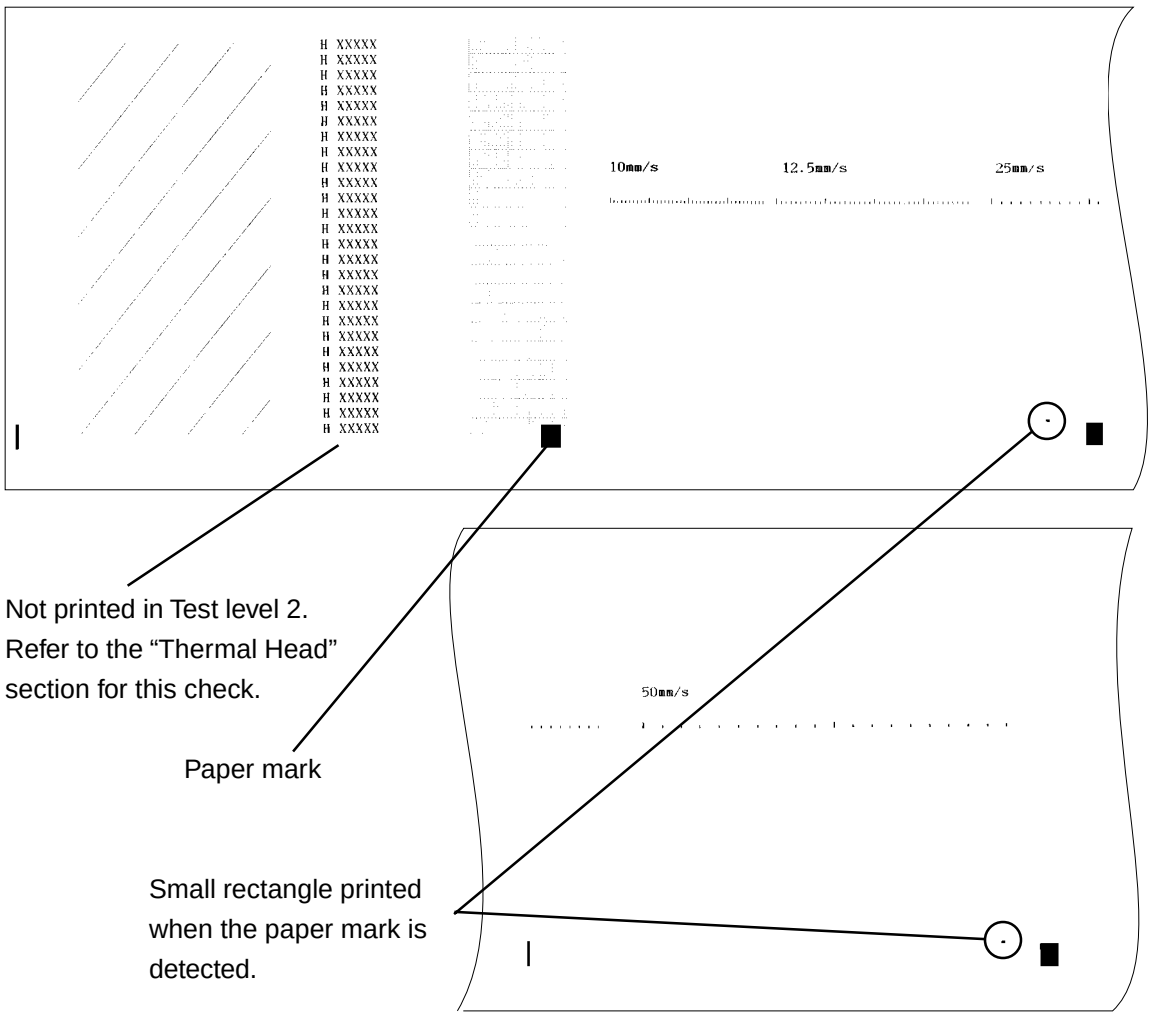
The recorder test of Test level 1 contains the same recorder test and thermal head test as Test level 2. With regard to the check procedure for characters H and X, refer to the “Thermal Head” section.

Procedure

Enter the system test number [01] (Test level 1) or [00] (Test level 2) and press the START/STOP key. The following test patterns are printed.

This test automatically ends after the folowing has been printed. The instrument returns to the standby mode for entering the system test number.

Printout of Test level 1



Check Procedure for Diagonal Lines

Check that all the diagonal lines are evenly and completely printed.

Possible Source of Problem	Corrective Action
A dirty thermal head can cause some parts to be unevenly or incompletely printed.	1. Clean the thermal head with the thermal head cleaner pen. 2. If this does not fix the problem, replace the thermal head.
A faulty thermal head can cause some parts at a certain position to be unevenly or incompletely printed.	1. Clean the thermal head with the thermal head cleaner pen. 2. If this does not fix the problem, replace the thermal head.

Check Procedure for Grid

Check that all the parts of the grid are clearly, evenly and completely printed.

Possible Source of Problem	Corrective Action
A faulty ECG control board can cause all or some parts to be unclear, unevenly or incompletely printed.	Replace the ECG control board.

Check Procedure for Paper Speed Scales

Check that the accuracy of each paper speed during actual recording is within 2%. The scales for 4 seconds at 10 mm/s and 12.5 mm/s paper speeds and the scales for 2 seconds at 25 mm/s and 50 mm/s paper speeds are consecutively printed. For example, the length for 4 seconds on the time scale printed at 10 mm/s paper speed must be within 39.2 mm to 40.8 mm.

Possible Source of Problem	Corrective Action
Badly positioned thermal head.	1. Adjust the thermal head position. 2. If this does not fix the problem, replace the thermal head.
Damaged, deformed or badly positioned motor gear.	1. Check the motor gear and its position. 2. If this does not fix the problem, replace the motor gear.
Dirty motor rotation sensor.	Clean the motor rotation sensor as described in the "Maintenance" section.
Loose or damaged axle.	Tighten and check the axle as described in the "Disassembly and Assembly" section.
Faulty motor.	Replace the motor.
Faulty ECG control board.	Replace the ECG control board.

Check Procedure for Paper Mark Detection

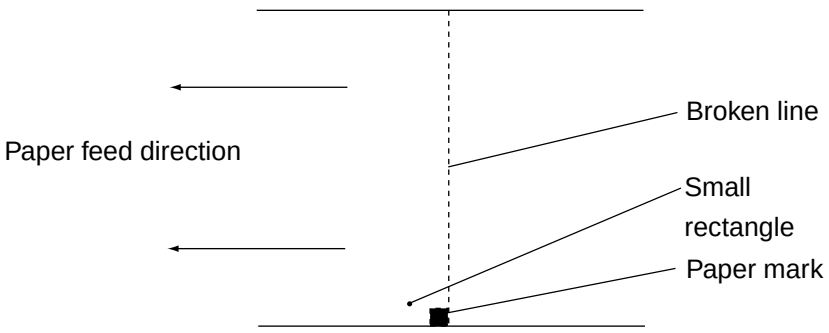
In one complete recorder test, a small rectangle is printed near each paper mark if the paper mark is correctly detected by the mark sensor. (Refer to “Cleaning and Greasing” in Section 2 for the location of the mark sensor.) Check that a small rectangle is printed before each paper mark on the second and third pages only.

Possible Source of Problem	Corrective Action
If the paper mark is not occasionally detected, the paper mark sensor is dirty.	Clean the paper mark sensor as described in the "Maintenance" section.
If the paper mark is not detected at all, the paper mark sensor board is faulty.	Replace the paper mark sensor board.

About paper mark

Every page of recording paper has a paper mark at the lower right corner. Pages are divided by broken lines. In the automatic recording, the recording stops after the paper mark is detected by the mark sensor. This enables the next printing to start from the beginning of the next page.

<Recording paper>



Thermal Head

This is used to check the condition of the thermal head by printing out the characters “H” and “X” continually.

Procedure

Enter the system test number [01] (Test level 2) and press the START/STOP key. The characters “H” and “X” are printed as follows.

To quit the test, press the AUTO/MANUAL key and the instrument returns to the standby mode for entering the system test number.

Printout of Thermal Head Test Result

```
H XXXXX H XXXXX H XXXXX H XXXXX H XXXXX
H XXXXX H XXXXX H XXXXX H XXXXX H XXXXX
H XXXXX H XXXXX H XXXXX H XXXXX H XXXXX
H XXXXX H XXXXX H XXXXX H XXXXX H XXXXX
H XXXXX H XXXXX H XXXXX H XXXXX H XXXXX
H XXXXX H XXXXX H XXXXX H XXXXX H XXXXX
H XXXXX H XXXXX H XXXXX H XXXXX H XXXXX
H XXXXX H XXXXX H XXXXX H XXXXX H XXXXX
H XXXXX H XXXXX H XXXXX H XXXXX H XXXXX
H XXXXX H XXXXX H XXXXX H XXXXX H XXXXX
H XXXXX H XXXXX H XXXXX H XXXXX H XXXXX
H XXXXX H XXXXX H XXXXX H XXXXX H XXXXX
```

Check Procedure for Characters H and X

Check that all the parts of the characters “H” and “X” are clearly, evenly and completely printed and that the characters are not printed zigzag or diagonally.

Possible Source of Problem	Corrective Action
Incorrectly set thermal head recording resolution setting.	Adjust the thermal head recording resolution as described in this section.
Faulty cable connection to the CNJ011 connector on the ECG control board or the CN031 connector on the power unit.	Check the cable connections to the CNJ011 connector on the ECG control board and the CN031 connector on the power unit.
Faulty power unit.	Replace the power unit.
Badly positioned recorder component.	Check and adjust the recorder component position.

Key

This is used to check the condition of the keys on the operation panel.

Procedure

1. Enter the system test number [02] (Test level 1) or [03] (Test level 2) and press the START/STOP key.

2. Press the key on the operation panel. The name of the pressed key is printed if the key is functioning correctly.

   To quit the test, press the AUTO/MANUAL key. The instrument returns to the standby mode for entering the system test number.

NOTE

The POWER and AUTO/MANUAL keys cannot be checked by this test. To check if these two keys are functioning correctly, do the following:

- **POWER key**
  Check that the power of the instrument is on or off when the POWER key is turned on or off.
- **AUTO/MANUAL key**
  Check that the Key test is stopped by pressing the AUTO/MANUAL key.

Check Procedure for Operation Panel Key

Check that the name of the pressed key is printed.

Possible Source of Problem	Corrective Action
Damaged membrane key.	Replace the membrane key.

Memory

This is used to check the condition of the memory by comparing the data of the test patterns written to and read from each memory area.

The instrument provides two memory test modes: single and continuous. When single memory test mode is selected, entire memory is tested once. When continuous memory test mode is selected, the memory is continuously tested until the AUTO/MANUAL key is pressed. The number of “Count of test” increases by one each time the entire memory test is tested. One complete memory test takes about 30 seconds.

If no fault is detected, an “OK” message appears for each memory. If a fault is detected, an “Error” message appears and the number of “Error count” for each memory increases by one.

Printout of Memory Test Result

Memory test result (Count of test: 1)

		Error count
Main memory (BIT/ADR)	OK	0
Recorder memory (BIT/ADR)	Error (E88004/000000h)	1
VRAM (BIT/ADR)	Error (C10000h/C10004h)	1
Program ROM	OK	0
Flash memory	NONE	0
Input unit SRAM	Error	1
Input unit ROM	OK	0
Input unit EEPROM	OK	0
File memory	Error	1

Hospital	NIHON KOHDEN HOSPITAL
Model	9020K
Version	01-01
Input unit version	01-01
Analizing version	01-01
Date	Apr 24, 1998 10:41 AM
Cardiograph internal temp	46.5 C
Elapsed time	0 hours
Thermal head temperature	36.0 C
Battery voltage	13.4 V

Single Memory Test Mode

This mode tests the entire memory once. You can use this mode to fully check all memory if a memory problem frequently occurs.

Procedure

Enter the system test number [03] (Test level 1) or [04] (Test level 2) and press the START/STOP key.

After the test, the test result is automatically printed. When the test result is completely printed, a “bing bong” alarm sound is generated and instrument returns to the standby mode for entering the system test number.

To cancel the test or cancel printing the test result, press the AUTO/MANUAL key.

Check Procedure for Single Memory Test Mode

Check that no “Error” messages appear.

Possible Source of Problem	Corrective Action
Faulty memory on the ECG control board.	Replace the ECG control board. Each memory mounted on the ECG control board cannot be replaced at memory component level.

Continuous Memory Test Mode

This mode continues testing the entire memory until the AUTO/MANUAL key is pressed. You can use this mode to check an intermittent memory problem.

Procedure

Enter the system test number [05] (Test level 2) and press the START/STOP key.

To print the test result without quitting the test, press the START/STOP key. All results of the tests performed until the START/STOP key are pressed is printed on one page.

To cancel the test, press the AUTO/MANUAL key. All results of the tests performed until the START/STOP key is pressed are printed on one page. When the test result is completely printed, 8 repeating “pips” alarm sound is generated and the instrument returns to the standby mode for entering the system test number.

Check Procedure for Continuous Memory Test Mode

Check that no “Error” messages appear.

Possible Source of Problem	Corrective Action
Faulty memory on the ECG control board.	Replace the ECG control board. Each memory mounted on the ECG control board cannot be replaced at memory component level.

LCD/LED

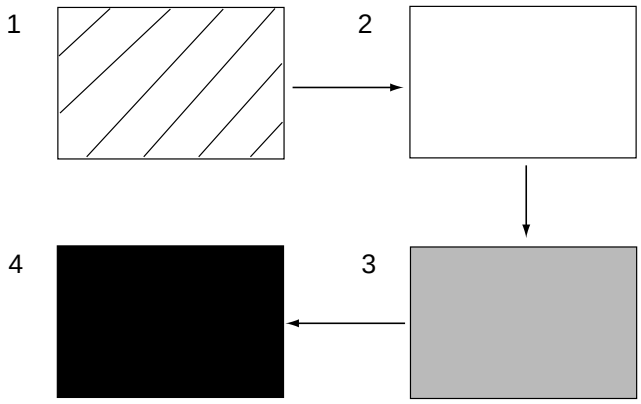
This is used to check all LEDs on the operation panel, LED/LCD control circuit and all dots on the LCD (ECG-9020K only). First, the LCD test starts and after the LCD test is complete, the LED test starts. The LCD test is not performed for the ECG-9010K.

LCD Test (ECG-9020K only)

The LCD displays the following four types of test patterns every two seconds in the following order:

1. Diagonal lines are displayed.
2. Entire LCD lights up.
3. LCD is completely dark but backlight lights.
4. Backlight does not light.

The LCD image for each pattern changes as follow:



LED Test

The LEDs on the operation panel light up by one and remain lit until all LEDs light up. After all LEDs light up, they go out at a time.

NOTE

With regard to the LEDs of Battery charge lamp, AC power lamp and POWER lamp, check if they are in the following condition during the LED/LCD test:

- **Battery charge lamp: Not lit (This lamp indicates the remaining battery power before and after the LED test during battery operation.)**
- **AC power lamp: Lit**
- **POWER lamp: Lit when AC power is used**

Procedure

Enter the system test number [04] (Test level 1) or [06] (Test level 2) and press the START/STOP key.

After the test, the instrument returns to the standby mode for entering the system test number.

To cancel the test, press the AUTO/MANUAL key.

Check Procedure for LCD Test

Check that all the dots on the screen light up and go out according to the test pattern.

Possible Source of Problem	Corrective Action
Faulty cable connection to the CNJ012 or CNJ013 connector on the ECG control board.	Check the cable connections to the CNJ012 and CNJ013 connectors on the ECG control board.
Faulty LCD module.	Replace the LCD module.
Faulty ECG control board.	Replace the ECG control board.

Check Procedure for LED Test

Check that all the LEDs on the operation panel light up.

Possible Source of Problem	Corrective Action
Faulty cable connection to the CNJ012 or CNJ013 connector on the ECG control board.	Check the cable connections to the CNJ012 and CNJ013 connectors on the ECG control board.
Damaged membrane key.	Replace the membrane key.
Faulty ECG control board.	Replace the ECG control board.

Input Unit

This is used to check if the input analog signal processing circuit detects the lead off condition correctly, using the provided input check jig. If each lead is connected when the input analog signal processing circuit works correctly, the "Normal" message is printed at the right of each electrode lead name in the test result. If a lead is not connected, the "Error" message is printed.

The following is an example printout of the input unit test result when the R(RA) lead is disconnected.

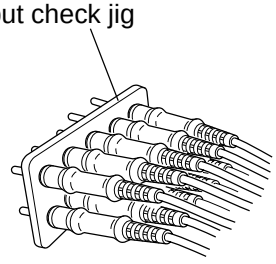
Input unit test result

RF (RL)	Normal
R (RA)	Error
L (LA)	Normal
F (LL)	Normal
C1	Normal
C2	Normal
C3	Normal
C4	Normal
C5	Normal
C6	Normal

Procedure

1. Connect the electrode lead to the instrument.
2. Attach all tips of each electrode lead to the input check jig.

Input check jig



3. Enter the system test number [05] (Test level 1) or [07] (Test level 2).
4. Disconnect one of the leads from the check jig and press the START/STOP key. The disconnected lead name is printed out.
5. Repeat steps 3 and 4 for all leads by one.

   To quit the test, press the AUTO/MANUALl key. The instrument returns to the stanby mode for entering the system test number.

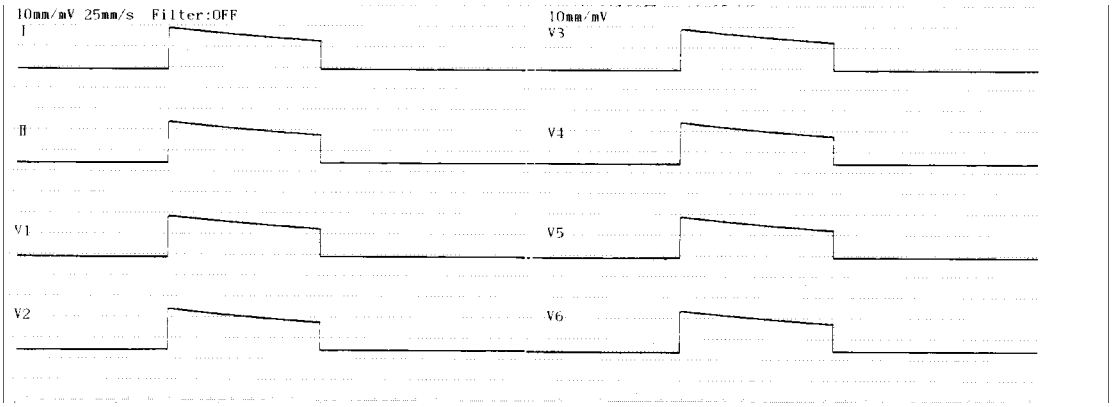
Check Procedure for Input Unit Test

Check that the lead off condition is detected correctly.

Possible Source of Problem	Corrective Action
Faulty ECG control board.	Replace the ECG control board.
Faulty input check jig.	Replace the input check jig.

Calibration

This is used to check the sensitivity and time constant of the input analog signal processing circuit. After starting the test, the CAL waveforms for leads I, II and V1 to V6 are printed as shown below. If all the rectangular printed CAL waveforms have the amplitude of 1 mV and time constant of more than 3.2 seconds, the sensitivity and time constant of the input analog signal processing circuit are normal.



Procedure

Enter the system test number [06] (Test level 1) or [08] (Test level 2) and press the START/STOP key.

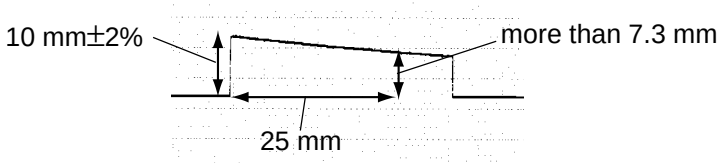
After all CAL waveforms for eight leads are printed, the test automatically ends and the instrument returns to the standby mode for entering the system test number.

To cancel the test, press the START/STOP key or AUTO/MANUAL key. The instrument returns to the standby mode for entering the system test number.

Check Procedure for Calibration Waveforms

Check that all the rectangular printed CAL waveforms match the following conditions in the illustration below:

- Amplitude when CAL waveform is risen: 10 mm±2%
- Amplitude of point which is 25 mm : from the rising point of the CAL waveform: more than 7.3 mm



Possible Source of Problem	Corrective Action
Faulty ECG control board.	Replace the ECG control board.

Communication

This is used to check the external communication input/output line of the instrument, using the check jig. The instrument has one standard communication connector (SIO). This test is performed by comparing the original test patterns sent from the output line with the test patterns received at the input line. If any received test pattern is different from its original, a “Error” message is printed. A “Normal” message is printed if the communication line is normal. With regard to TxD-RxD line, if the same data is printed, the line is normal.

Every time the test of one set is repeated, the number of “Count of test” increases by one. Every time the error is detected during continuous test, the “Error count” increases by one. The test of one set takes about 5 seconds.

The following is an example printout of the communication test result.

Communication test result (Count of test: 1)

Error count
0

DTR-DSR:	Normal
RTS-CTS:	Normal
TxD:	00
RxD:	00

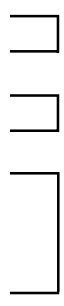
Hospital	NIHON KOHDEN HOSPITAL
Model	9020K
Version	01-01
Input unit version	01-01
Analizing version	01-01
Date	Apr 24, 1998 10:41 AM
Cardiograph internal temp	46.5 C

Preparation

A locally made check jig is required for the test. To make the check jig, short-ciruit the pins as shown below.

Connector Pin Assigment

1. FG
2. TXD
3. RXD
4. RTS
5. CTS
6. DSR
7. GND
8. HS
9. DTR



Mating Connector

Connector: HDEB-9PF (05)
Case: HDE-CTH

Procedure

1. Connect the check jig to the SIO socket of the instrument.

2. Enter the system test number [07] (Test level 1) or [09] (Test level 2) and press the START/STOP key.

   The instrument prints the test result of each test if the instrument detects an "Error".

   To print the test result without quiting the test, press the START/STOP key. The results of all tests performed until the START/STOP key are pressed are printed. You can see the test number and the number of errors on "Count of test" and "Error count" on the printout, respectively.

   To quit the test, press the AUTO/MANUAL key. The instrument prints the results of all tests performed until the AUTO/MANUAL key is pressed. When the test result is completely printed, 8 repeating "pips" sound is generated and the instrument returns to the standby mode for entering the system test number.

Check Procedure for Serial Communication

Check that no error messages appear.

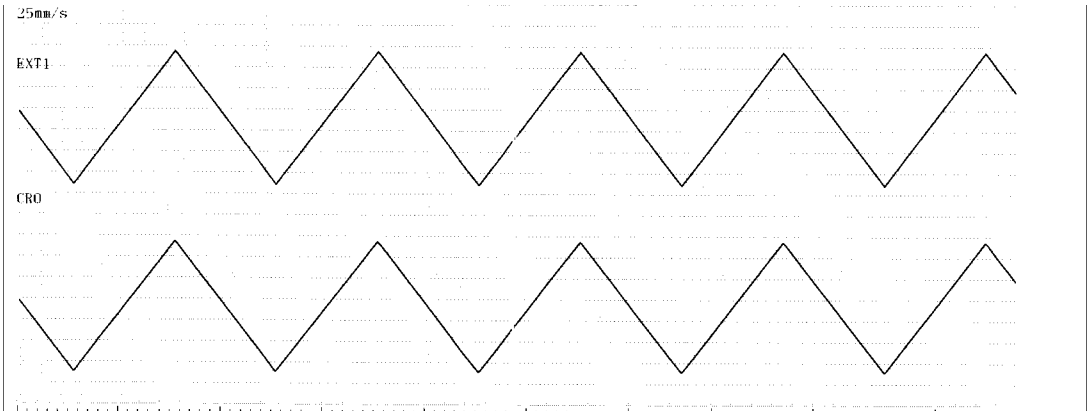
Possible Source of Problem	Corrective Action
Faulty ECG control board.	Replace the ECG control board.

CRO/EXT1

This is used to check the external output/input terminal, using the check jig. The instrument has the input signal terminal (EXT-IN connector) and output signal terminal (CRO-OUT connector) at the rear of the instrument.

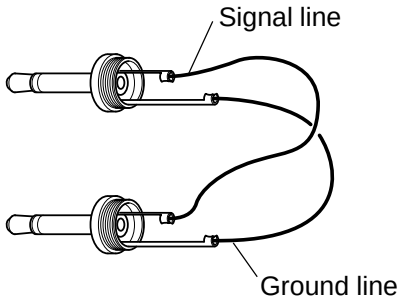
In this test, the instrument prints the known triangular waveform signals generated inside the instrument at the lower trace on the recording paper the moment the instrument outputs the signals from the CRO-OUT terminal to the EXT-IN connector. At the same time, the instrument prints the triangular waveform signals input to the EXT-IN connector at the upper trace on the recording paper. There is no delay time between the printed waveforms on the upper and lower traces.

The following is an example printout of the CRO/EXT1 test result.



Preparation

A locally made check jig is required for the test. To make the check jig, use the two 3.5ϕ monaural jacks and leads and solder the signal line and ground line of the two jacks with leads as shown below.



Procedure

1. Connect the check jig to the CRO-OUT/EXT-IN sockets of the instrument.

2. Enter the system test number [08] (Test level 1) or [10] (Test level 2) and press the START/STOP key.

   To quit the test, press the START/STOP key or AUTO/MANUAL key. The instrument returns to the standby mode for entering the systme test number.

Check Procedure

Check that the shape of the two printed triangular waveforms are the same and there is no delay time between them.

Possible Source of Problem	Corrective Action
Faulty ECG control board.	Replace the ECG control board.

System Setup Initialization

This is used to reset all the system settings to the factory initial settings.

NOTE

The following settings are not reset to the factory initial settings even if the instrument is initialized.

- **date and time***
- **recording resolution setting***
- **cue mark position***
- **elapsed time**
- **saved ECG data**
- **display language****
- **hospital name****
- **direct/modem connection****
- **local language font**

For settings marked with *, refer to the following corresponding subsection in this section; for settings marked with **, refer to "Changing Settings Before Measurement (System Setup Screen)" in the ECG-9010K/9020K operator's manual.

Procedure

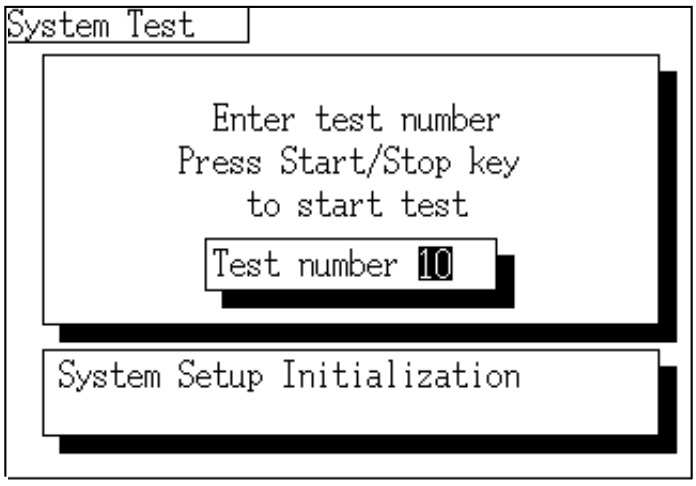
Enter the system test number [10] (Test level 1) or [12] (Test level 2) and press the START/STOP key.

If the initialization is completed, the folloing occurs:

- ECG-9010K: One "bing bong" alarm sound is generated and the instrument returns to the stanby mode for entering the system test number.
- ECG-9020K: A "System Setup Initialization" message appears with one "bing bong" alarm sound and the instrument returns to the stanby mode for entering the system test number.

Refer to the ECG-9010K/9020K operator's manual for the factory initial settings.

Following is the LCD display after the system has been initialized.



ECG Findings List Recording

This is used to print out the list of all ECG findings used for the instrument. The instrument informs you of the ECG finding as a result of the ECG interpretation when analyzing the ECG.

Procedure

Enter the system test number [11] (Test level 1) and press the START/STOP key.

When the list is completely printed, one “bing bong” alarm sound is generated and the instrument returns to the standby mode for entering the system test number.

To cancel printing the list, press the START/STOP key or AUTO/MANUAL key. The instrument returns to the standby mode for entering the system test number.

Recording Resolution Setting

This is used to adjust the thermal head recording resolution after the thermal head is replaced with a new one or when the printout is not clearly, evenly and completely printed.

Normally, the resistor value of the heating element on the thermal head is a specific value which varies from thermal head to thermal head. Even if the same energy is applied to the thermal head, the recording quality varies due to the difference of the thermal head resistor value. Therefore, adjusting the thermal head recording resolution is required to evenly print regardless of the thermal head resistor value.

Do the following procedure to automatically adjust the thermal head recording resolution.

Procedure

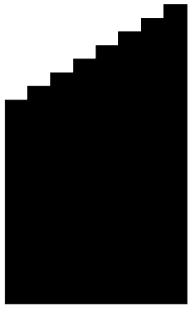
Enter the system test number [02] (Test level 2) and press the START/STOP key.

After adjustment is completed, the instrument prints out the test result as shown below and returns to the stanby mode for entering the system test number.

A number of 1 to 8 is printed at the right of “Thermal head level” if the thermal head resolution is adjusted correctly. An “Error” is printed when it is necessary that the thermal head is replaced with a new one.

The following is an example printout of the Recording Resolution Setting system test.

Thermal head level: 4



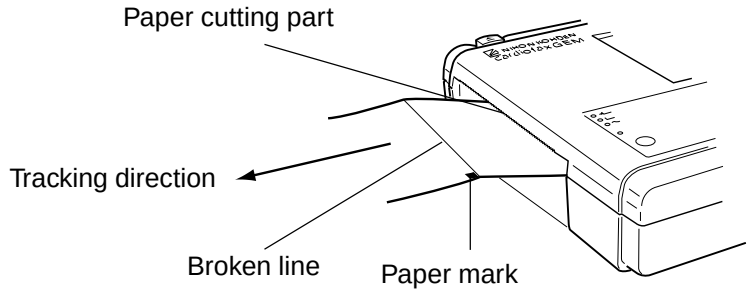
Cue Mark Adjustment

This is used to adjust the distance (mm) between the broken line on the recording paper and paper cutting part on the top casing so that the paper can be just cut at the broken line. The ideal adjustment is that the broken line on the paper lines up with the cutting part on the top casing when cutting the paper.

Procedure

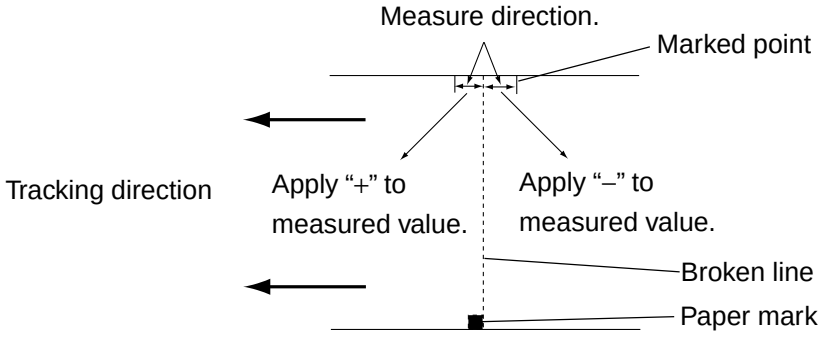
1. Enter the system test number [21] (Test mode 2) and press the START/STOP key to verify the distance between the broken line on the paper and the paper cutting part. The instrument feeds the recording paper with the "Cue mark adjustment (0.0 mm)" message and stops feeding it after a paper mark is detected. The right edge of the paper mark against the paper tracking direction lines up the broken line on the paper.

2. Put the paper to the paper cutting part as if the paper was cut as shown below. If the broken line lines up the paper cutting part, you do not have to perform this adjustment. If there is a deviation between the broken line and paper cutting part, go to step 3.



3. Mark the point where the paper is at the paper cutting part.

4. Measure the distance (mm) between the broken line and marked point.



5. Apply the plus symbol "+" to the measured value when the marked point is before the broken line against the tracking direction of paper or minus symbol "–" to the measured number when the marked point is behind the broken line. The resulting value is recognized as the adjustment value.

The following is a list of the relationship between the adjustment value and its corresponding system test number you should execute.

System Test No.	Adjustment Value (mm)	System Test No.	Adjustment Value (mm)
[13]	– 4.0	[21]	0.0
[14]	– 3.5	[22]	+ 0.5
[15]	– 3.0	[23]	+ 1.0
[16]	– 2.5	[24]	+ 1.5
[17]	– 2.0	[25]	+ 2.0
[18]	– 1.5	[26]	+ 2.5
[19]	– 1.0	[27]	+ 3.0
[20]	– 0.5	[28]	+ 3.5

6. Enter the appropriate system test number [*xx*] and press the START/STOP key. The “Cue mark adjustment [*xxx* mm]” message is printed and the instrument returns to the standby mode for entering the system test number. The adjustment is completed.

7. Verify that the broken line on the paper lines up with the cutting part on the top casing.

Date and Time Setting

The date and time of the instrument are set in the System Setup mode. In the System Setup mode, you can also set the entire system settings of the instrument which determines the operation conditions of the instrument. Refer to the ECG-9010K/9020K operator's manual for details.

This setting is necessary when the back-up battery (lithium battery) is completely or almost completely discharged or replaced with a new one. The life time of the back-up battery is about 7 years. You can note whether the back-up battery is completely or almost discharged by the system error message. Refer to the "System Error Message" section in Section 3.

Setting the Date and Time

1. Call up the System Setup mode
   1) If the power is on, turn it off.

NOTE

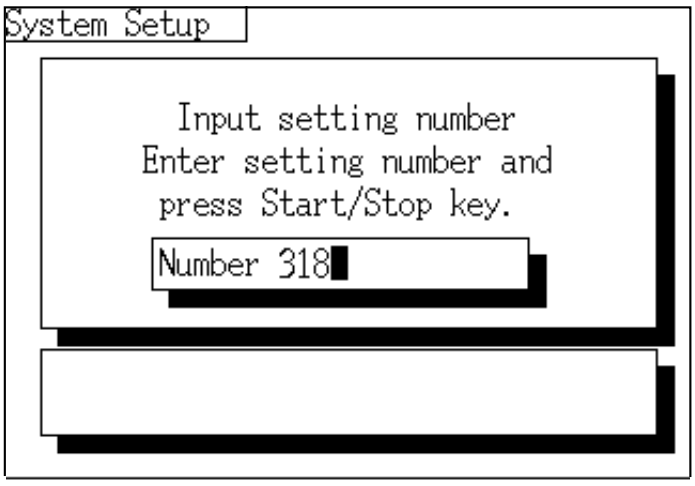
Release the FEED/MARK key immediately after the instrument starts printing. If you continue to hold the FEED/MARK key for more than 15 seconds, the instrument recognizes that the FEED/MARK key is short-circuited and prints the system information "Error 05" at the end of printing.

   2) Press the POWER key while pressing the COPY/CAL key. Hold the COPY/CAL key until the instrument begins to print the list of the system setup settings. The System Setup mode is called up.

      To cancel printing the list, press the START/STOP key.

2. Enter a 3-digit number to call up the stanby mode for entering the new numbers for year, month/date, hour/minute or second, respectively. Refer to the "Entering the System Test Number" in this section for entering the numbers.

   Following is the LCD screen when the year setting mode is called up.



Year
Enter the system setup number [318].

Month/date
Enter the system setup number [319].

Hour/minute
Enter the system setup number [320].

Second
Enter the system setup number [322].

To cancel the entered number, press the AUTO/MANUAL key.

NOTE
You cannot enter numbers for "second" setting.

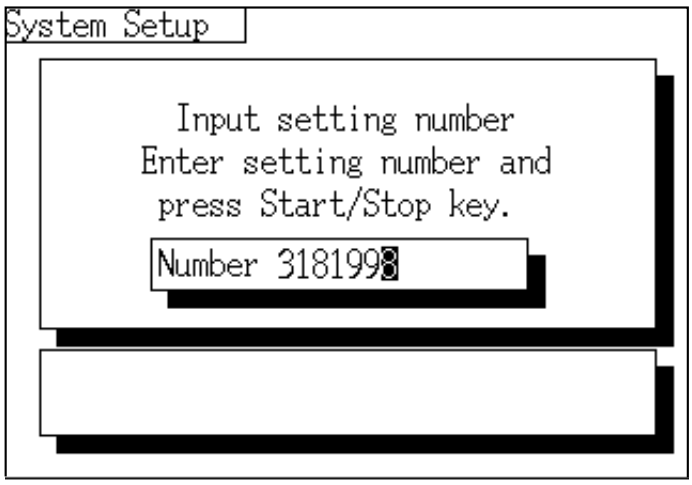
3. Enter a 4-digit number to enter the new numbers of the year, month/date or hour/minite. The range of the number which is possible to enter is as follows:
   Year
   [1980] to [2079]

   Month/date
   [0101] to [1231]

   Hour/minute
   [0000] to [2359]

   To cancel the entered number, press the AUTO/MANUAL key.

   Following is the LCD screen when the year "1998" is entered.

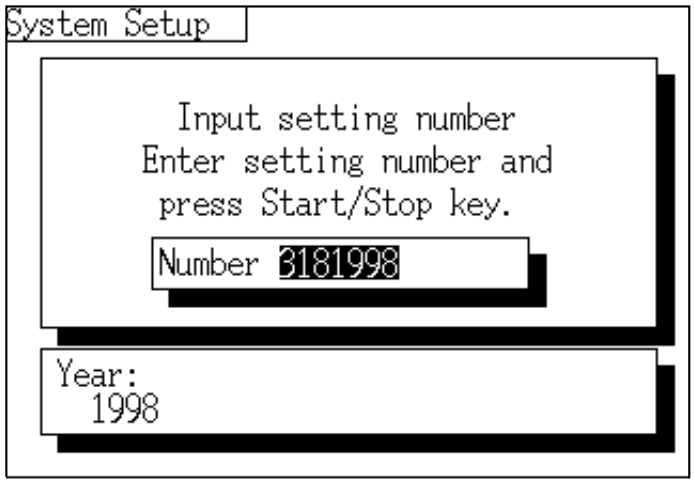


NOTE

- **If the START/STOP key is pressed in the "second" setting mode, the second is reset to "00" seconds and the instrument starts working from "00" seconds.**
- **If the power of the instrument is turned off before the START/STOP key is pressed, the newly entered numbers are invalid.**

4. Press the START/STOP key to save the new numbers. The newly entered numbers are automatically printed.

   Following is the LCD screen when year "1998" is saved.



   If you entered an unspecified number, an alarm occurs. The alarm indication is different between the ECG-9010K and ECG-9020K as follows:
   - ECG-9010K: 8 repeating "pips" alarm sound is generated.
   - ECG-9020K: 8 repeating "pips" alarm sound and the "Invalid number. Please re-enter number" error message is displayed.

   To re-enter the system test number, do either of the folowing:
   - Delete the previously entered number by pressing the AUTO/MANUAL key.
   - Enter the system test number by overwriting the previously entered number.

5. Repeat steps 2 to 4 to enter the new numbers for the other setting.

6. Turn the power of the instrument off to exit the System Setup mode.

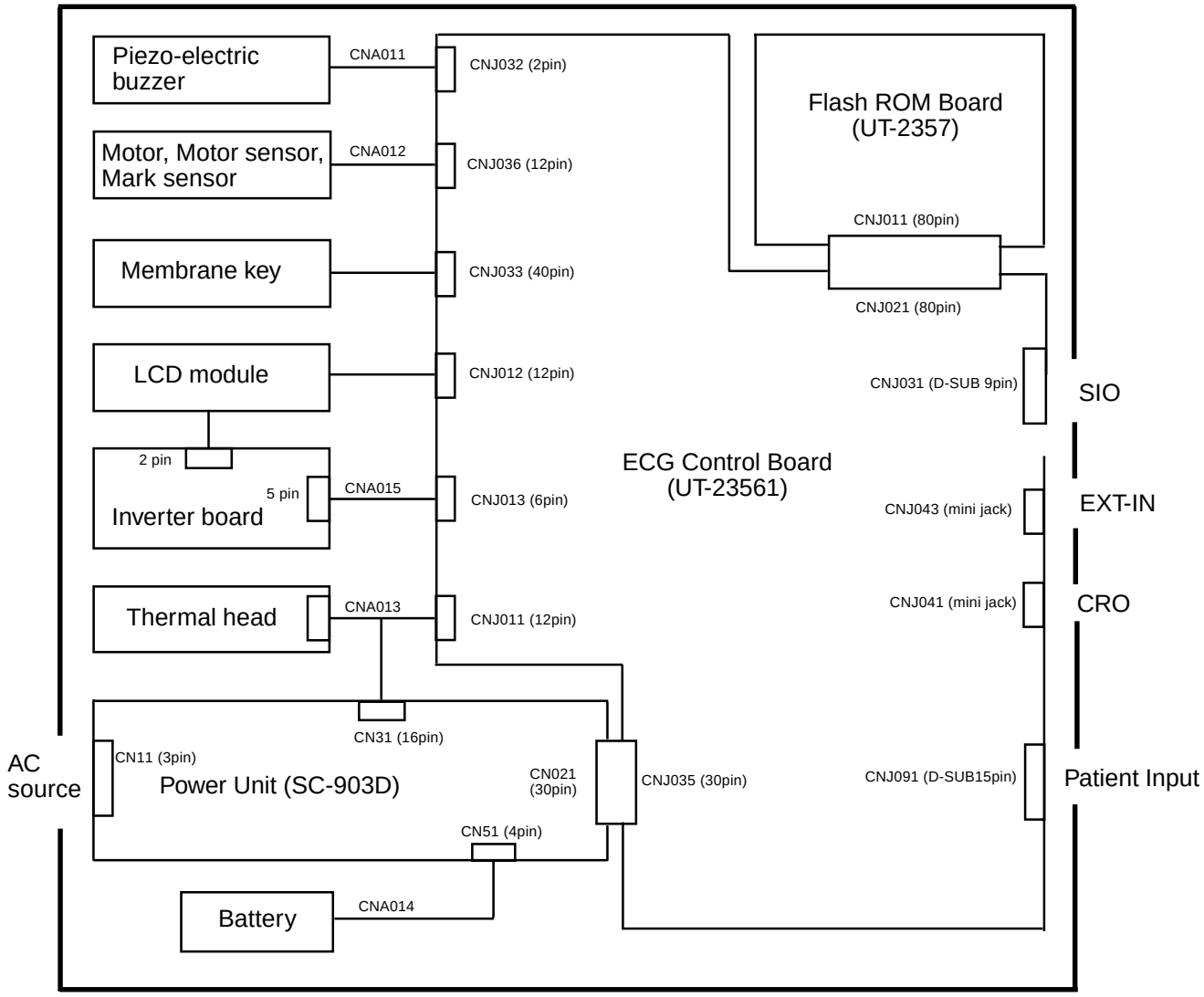
Section 5 Board/Unit Description

Block Diagram 5.1
Power Unit 5.2
ECG Control Board 5.2
Flash ROM Board 5.3
Inverter Board 5.3

Block Diagram

NOTE

The LCD module and inverter board are used for the ECG-9020K only.



Power Unit

The Power unit consists of the power source, battery charging and control circuits. The Power unit uses the switching regulation method to produce the power required for the instrument.

ECG Control Board

The ECG Control board consists of the following components:

Component	Description
CPU:	MC68EC020 (Operating frequency: 25 MHz)
ROM:	For system software, 2 MB
DRAM:	Main memory, 1 MB
Flash memory:	For font of local language, 1 MB
	For filing data, 256 KB
Real time clock:	For monitoring back-up battery, built-in 140 B SRAM
Timer:	1 ms timer
	Interrupt request signal ON/OFF: selectable
	Operation mode: fixed
Serial interface:	Equivelent to RS-232C, 1 channel
	Baud rate: 2,400 to 115,200 bps selectable
Speaker circuit:	Beep sound, Sound by noise generator
Interrupt request:	Auto-vector method
Interface:	To ECG input section
Recorder:	
LCD:	
Controller:	For keyboard
A/D converter:	

Flash ROM Board

The Flash ROM board has a 2 MB flash ROM for writing the control program, analysis program, Japanese font and English font to the ROM. Also, there is a space for mounting an EEPROM.

Inverter Board

The inverter board produces the power for the LCD backlight module using +12 VDC power from the power unit, and turns on/off the power of the instrument according to the signal from the ECG control board.

Section 6 Disassembly and Assembly

Before You Begin 6.1
Warnings and Cautions 6.1
Required Tools 6.1
Board and Unit Location 6.2
Cable Connection 6.3
Removing the Top Casing 6.4
Removing the LCD Assy 6.5
Removing the Thermal Head Assy 6.6
Removing the Motor Assy 6.8
Removing the Speaker Assy 6.9
Removing the Inverter Board 6.10
Removing the ECG Control Board 6.11
Removing the Power Unit 6.12
Replacing the Thermistor and Termistor Cable 6.14
Removing the Battery Terminal Assy 6.15
Removing the Magazine Assy 6.16
Removing the Bottom Casing 6.17
Replacing the Fuse on the Power Board 6.18
Replacing the Lithium Battery on the ECG Control Board 6.19

The procedures in this section tell how to remove, replace and install major components in the instrument.

Before You Begin

Removing, replacing and installing major components should be done by qualified service personnel.

Warnings and Cautions

WARNINGS

- **To avoid the possibility of injury to yourself or damage to the instrument, do not install or remove any component or change switch settings while the power is on and wait 10 minutes before installing to or removing any component from the instrument after the power is off.**
- **To avoid accidental discharge of static electricity which could damage the instrument components, use a wrist ground strap when installing or removing any component of the instrument.**

CAUTIONS

- **Before connecting or disconnecting any cables, turn off the instrument, unplug the AC power cord from the instrument and remove the rechargeable battery.**
- **Fuses cut off the power when an abnormality occurs in the instrument. Eliminate the malfunction before replacing the fuse. Use the correct fuse only. The fuse rating is shown on the holder.**
- **Removal and replacement of any component in the instrument should be done by qualified service personnel.**
- **Use only parts recommended by Nihon Kohden to assure maximum performance from your instrument.**

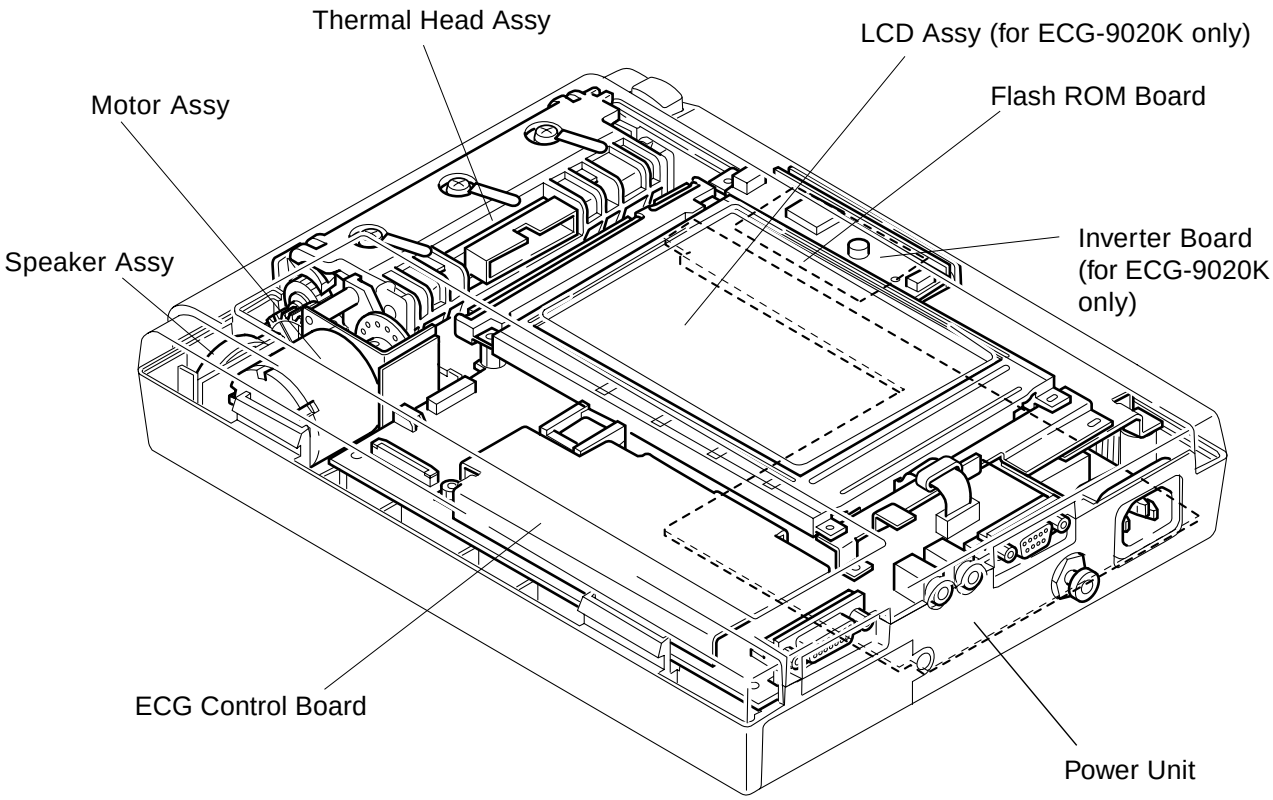
Required Tools

- Anti-static bench mat
- Wrist ground strap
- Phillips screwdriver (insulated type)
- Flat-blade screwdriver (insulated type)
- Hex (Allen) wrench or hex keys
- Hex driver
- Tweezers

Board and Unit Location

The following see-through diagram shows the location of the boards and units in the instrument.

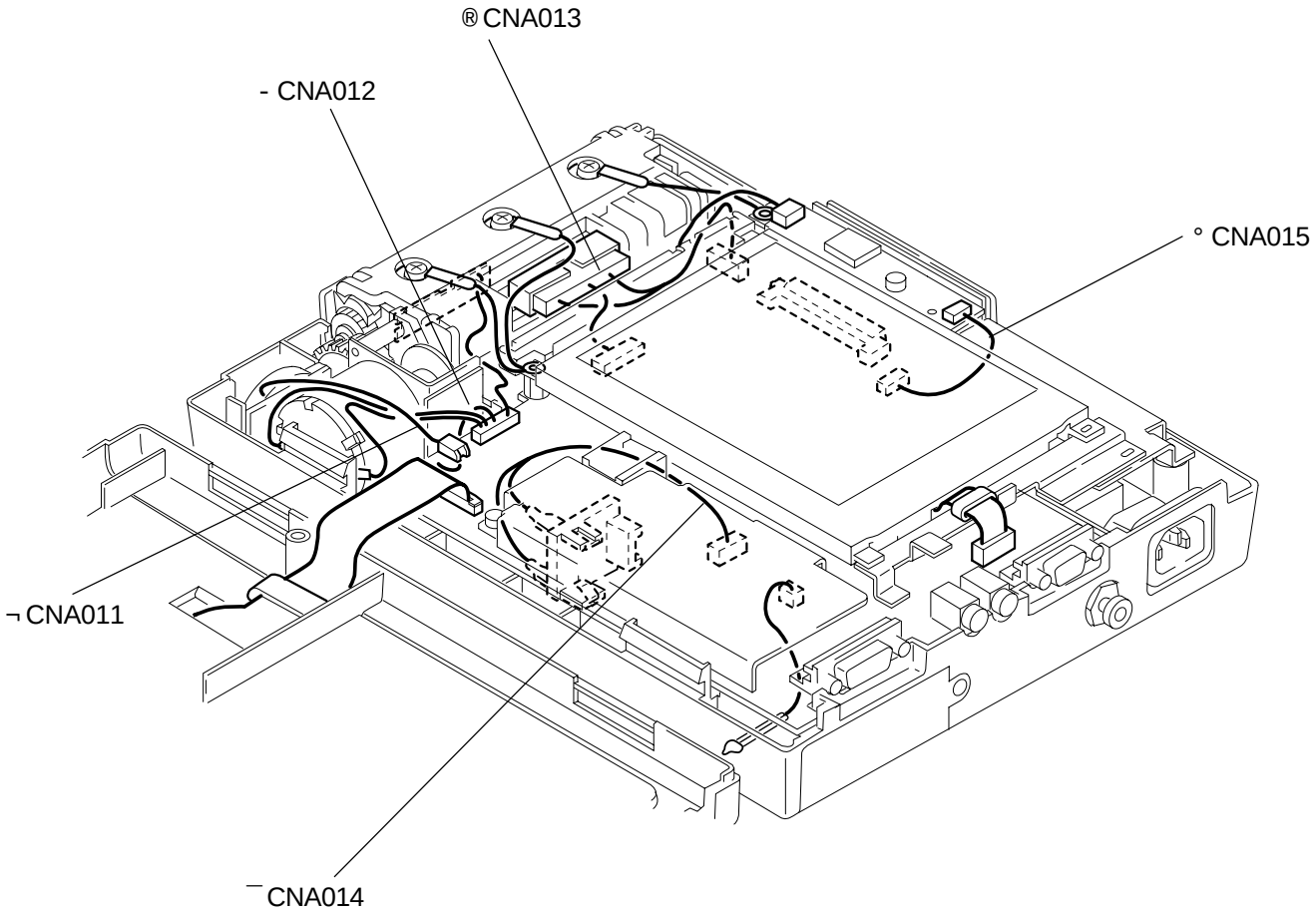
See-through Diagram



Cable Connection

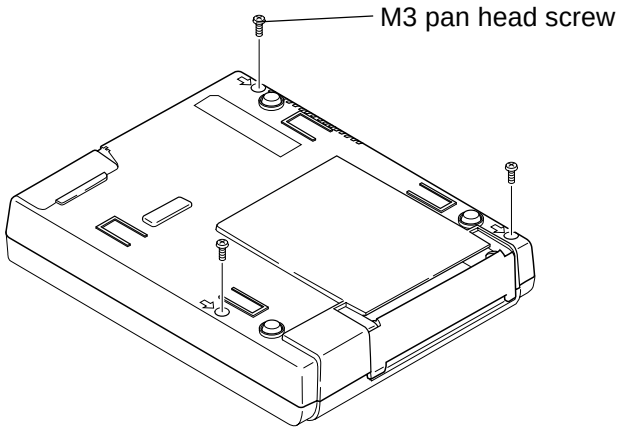
The following cable connection diagram shows the connection of the cables in the instrument.

Cable Connection Diagram



Removing the Top Casing

1. Reverse the instrument and remove the three M3 pan head screws.

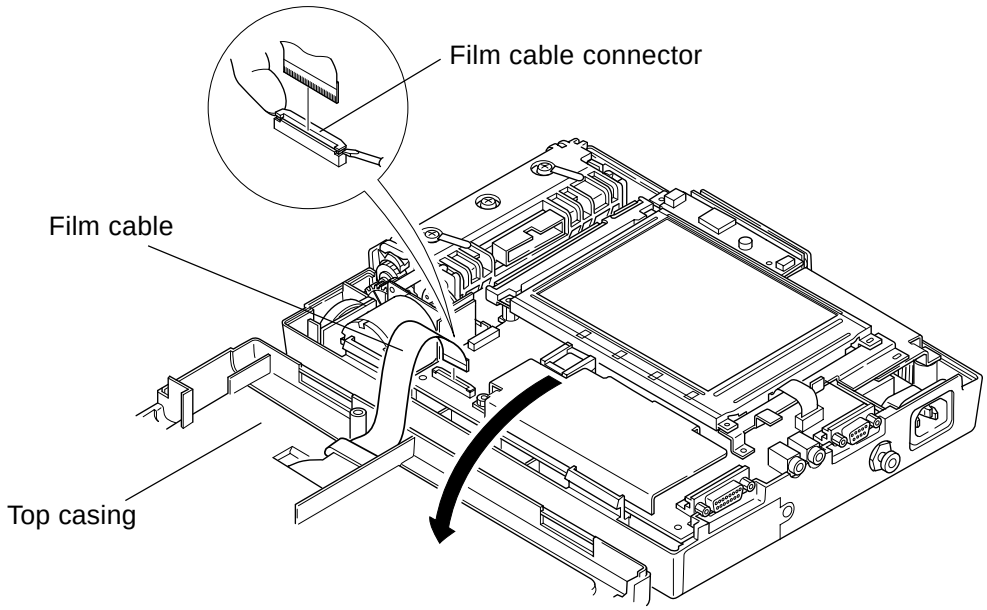


CAUTION

When opening the top casing, be sure not to let the top casing fall off. Otherwise, the film cable which connects the top casing and ECG control board and the film cable connector may be damaged. If the film cable is damaged, you must replace it with a new top casing assy.

2. Open the top casing in the direction of the arrow shown below.

3. Release the lock of the film cable connector with the small flat blade driver and your finger as shown in the expanded illustration and remove the film cable.



Removing the LCD Assy

NOTE

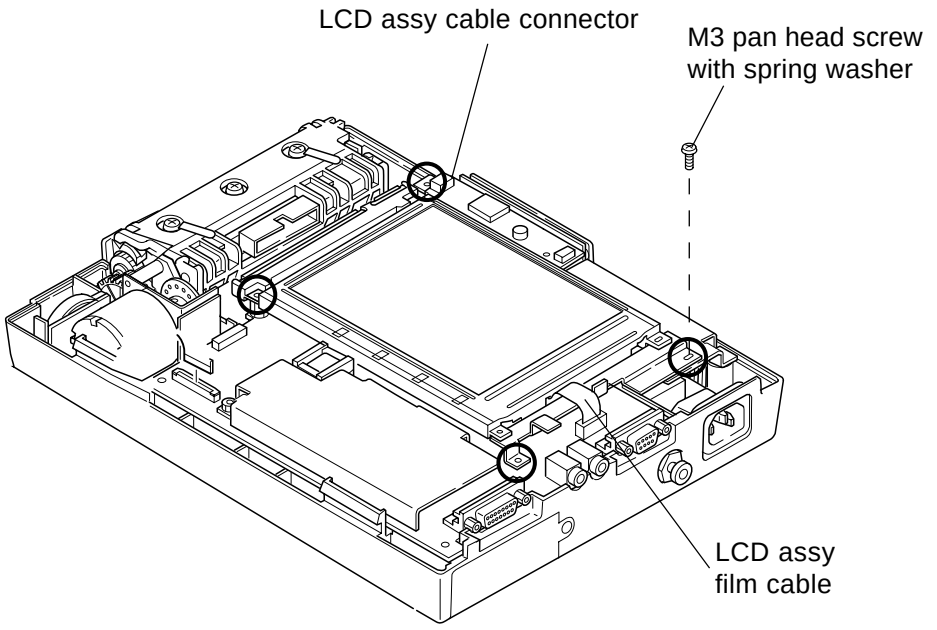
This procedure is used for the ECG-9020K only.

1. Remove the top casing as described in the “Removing the Top Casing” section.

2. Remove the four M3 pan head screws with spring washers which are marked with circles shown below.

3. Disconnect the LCD assy cable from the ECG control board.

4. Lift up the LCD assy so that the LCD assy flat cable is perpendicular to the ECG control board and pull out the LCD assy film cable from the connector on the ECG control board to remove it.



Removing the Thermal Head Assy

CAUTION

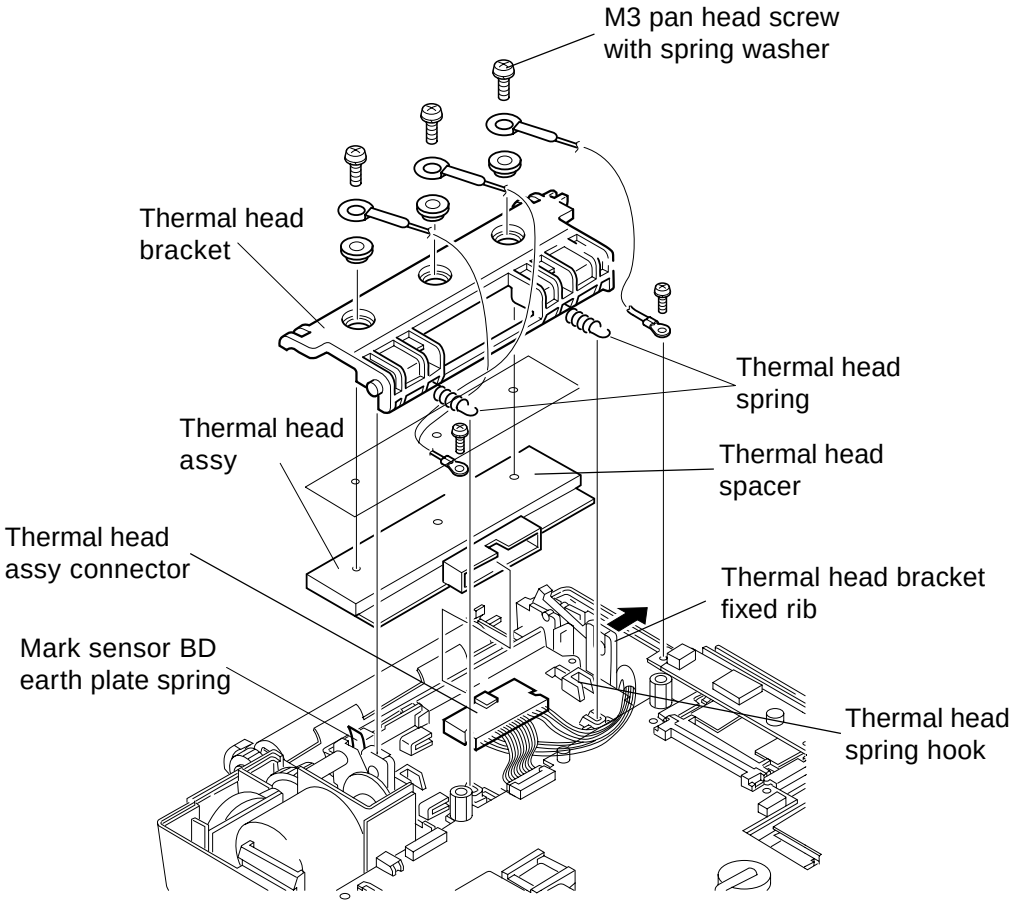
Do not touch the surface of the thermal head with your bare hands. This can cause some dots of the thermal head to malfunction. If you touch the surface of the thermal head, clean it with the provided thermal head cleaner pen or cotton moistened with alcohol.

1. Remove the top casing as described in the “Removing the Top Casing” section.

2. Remove the LCD assy as described in the “Removing the LCD Assy” section. This step is for the ECG-9020K only.

3. Disconnect the thermal head assy connector from the thermal head assy.

4. Push the thermal head bracket fixed rib in the direction of the arrow shown below and lift off the thermal head bracket from the thermal head bracket fixed rib. If the thermal head bracket is not removed completely, push the other side of the thermal head bracket fixed rib the same as above and completely lift off the thermal head bracket.



5. Remove the thermal head springs from the thermal head spring hooks.

6. Remove the three M3 pan head screws with spring washers.

CAUTIONS WHEN REPLACING

- **Replace the thermal head bracket so that the mark sensor BD earth plate spring is not damaged.**
- **Hook the thermal head springs to the thermal head spring hooks after replacing the thermal head bracket.**

Removing the Motor Assy

1. Remove the top casing as described in the “Removing the Top Casing” section.

2. Remove the LCD assy as described in the “Removing the LCD Assy” section. This step is for the ECG-9020K only.

3. Remove the thermal head bracket as described in the “Removing the Thermal Head Assy” section.

4. Remove the two M3 pan head screws holding the motor assy to the bottom casing.

5. Disconnect the motor assy connector from the ECG control board.

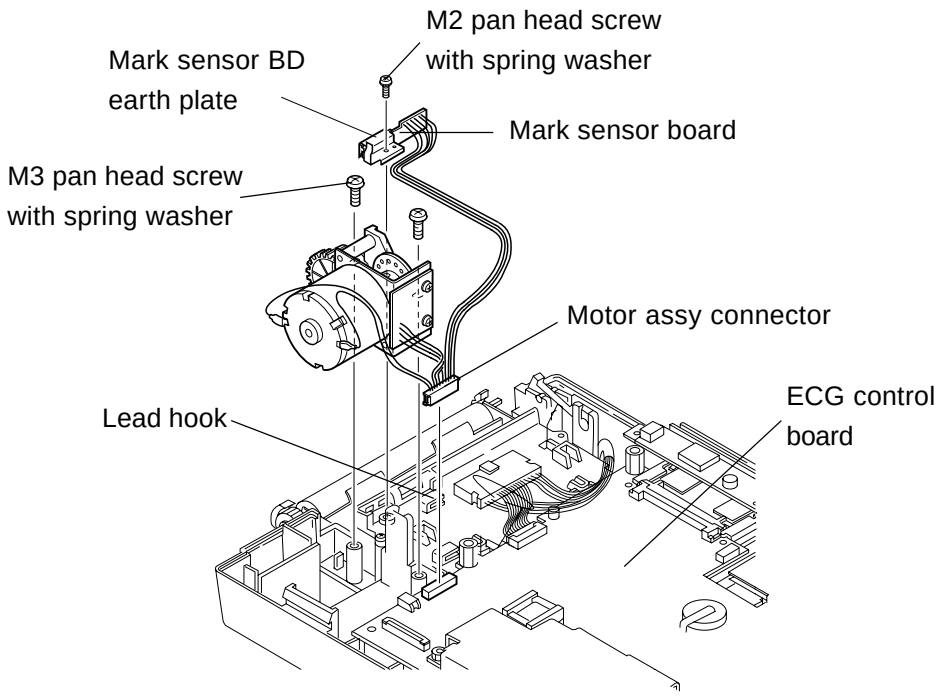
6. Remove the bundle of leads which connects the mark sensor board and ECG control board from the lead hook.

7. Remove the M2 pan head screw with spring washer holding the mark sensor BD earth plate to the bottom casing.

NOTE

The motor assy does not contain the motor sensor BD earth plate. To order the motor sensor BD earth plate, refer to “General Parts List” in Section 8.

8. Lift off the motor sensor board with the motor sensor BD earth plate.

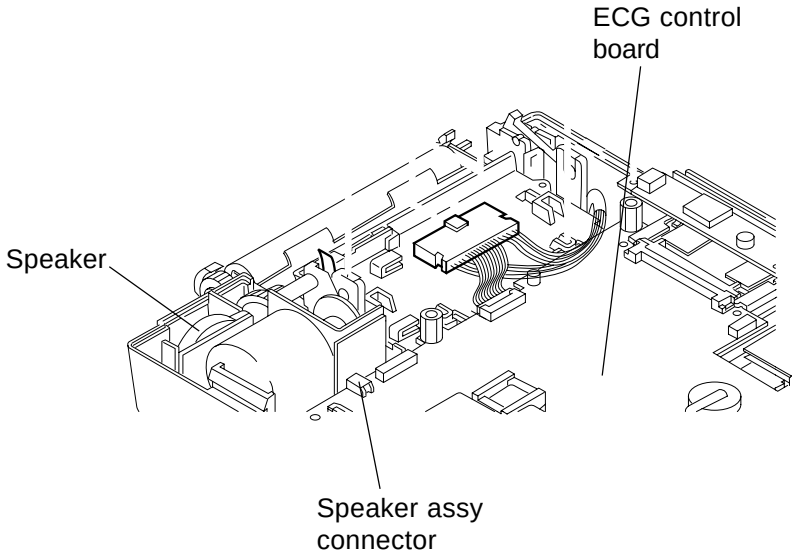


Removing the Speaker Assy

1. Remove the top casing as described in the “Removing the Top Casing” section.

2. Remove the LCD assy as described in the “Removing the LCD Assy” section. This step is for the ECG-9020K only.

3. Disconnect the speaker assy connector from the ECG control board.



Removing the Inverter Board

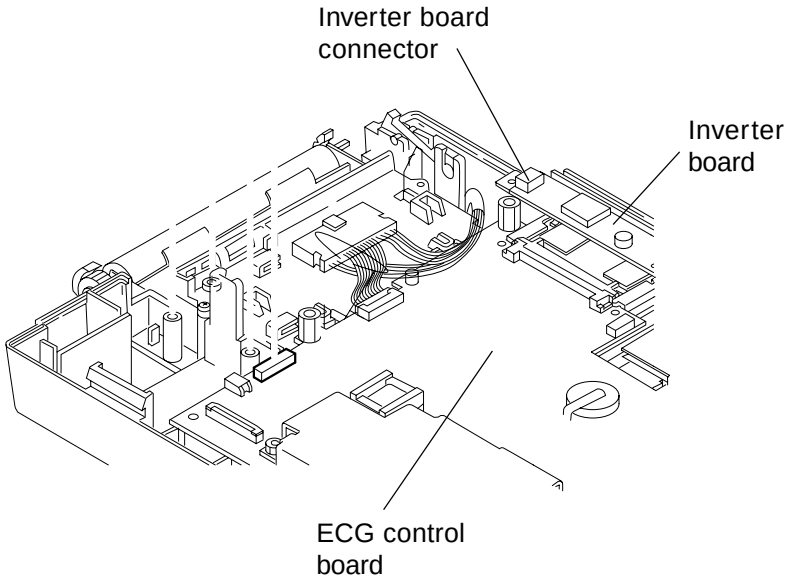
WARNING

The inverter board has a high voltage circuit for the LCD backlight. This can cause shock up to 10 minutes after the power is turned off. After the power is turned off, wait 10 minutes before disassembling the instrument.

NOTE

This procedure is used for the ECG-9020K only.

1. Remove the top casing as described in the “Removing the Top Casing” section.
2. Remove the LCD assy as described in the “Removing the LCD Assy” section. This step is for the ECG-9020K only.
3. Remove the M2 pan head screw holding the inverter board to the ECG control board.
4. Remove the bundle of leads which connects the inverter board and ECG control board from the mini clamp on the power unit.
5. Disconnect the inverter board connector from the ECG control board.
6. Lift off the inverter board from the ECG control board.



Removing the ECG Control Board

CAUTION

Local language text is stored in the flash memory on the ECG control board. When the ECG control board is replaced, local language text is not available; only English text is available. To use the ECG with your own language after the ECG control board is replaced, you must reload the local language files to the ECG. Refer to the YZ-012H6 Translator Support Tool operator's manual.

1. Remove the top casing as described in the "Removing the Top Casing" section.

2. Remove the LCD assy as described in the "Removing the LCD Assy" section. This step is for the ECG-9020K only.

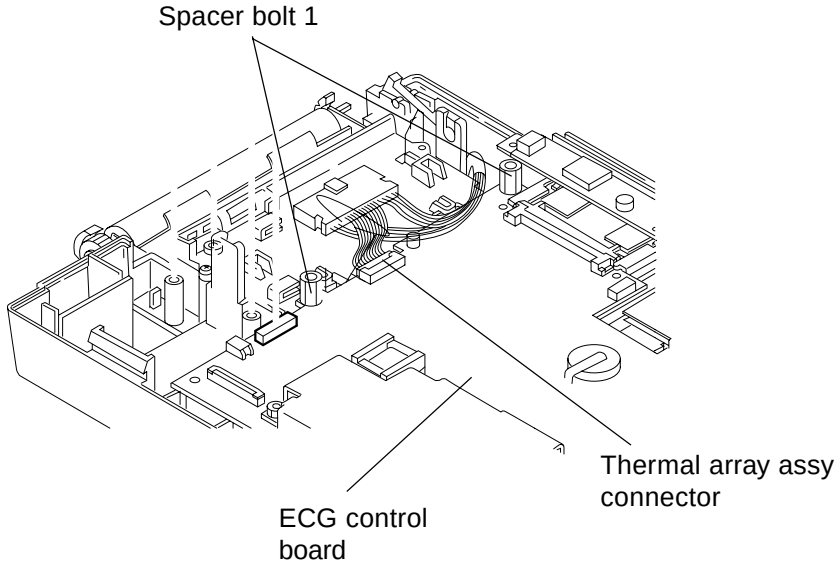
3. Remove the inverter board as described in the "Removing the Inverter Board" section. This step is for the ECG-9020K only.

4. Remove the three M3 pan head screws with spring washers.

5. Remove the two spacer bolts 1.

6. Disconnect the thermal array assy connector from the ECG control board.

7. Lift off the ECG control board from the power board. The CNJ035 connector on the ECG control board is directly connected to its socket on the power board.



Removing the Power Unit

1. Remove the top casing as described in the “Removing the Top Casing” section.

2. Remove the LCD assy as described in the “Removing the LCD Assy” section. This step is for the ECG-9020K only.

3. Remove the inverter board as described in the “Removing the Inverter Board” section. This step is for the ECG-9020K only.

4. Remove the ECG control board as described in the “Removing the ECG Control Board” section.

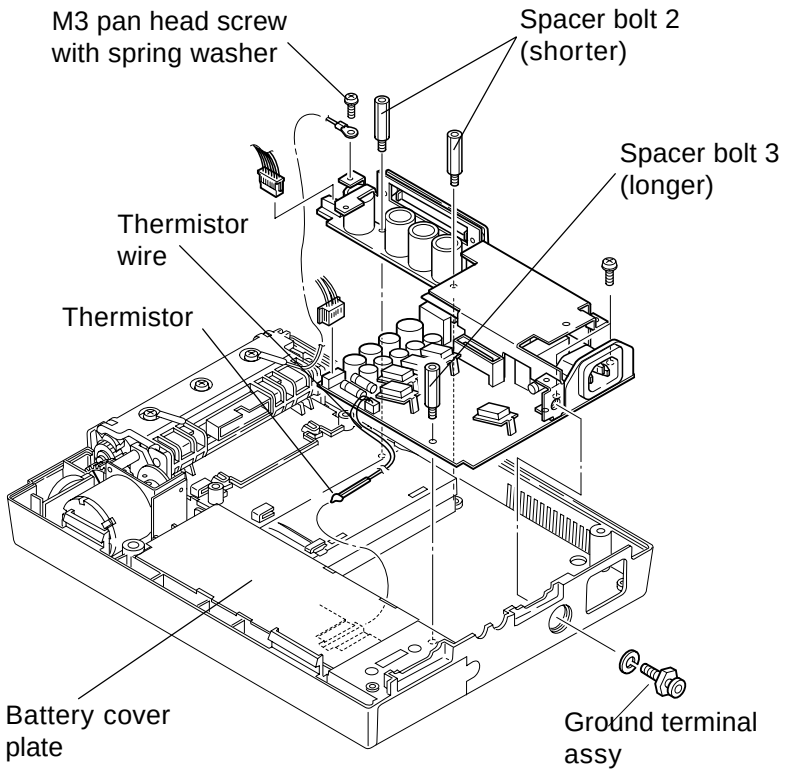
5. Remove the ground terminal assy.

6. Remove the two M3 pan head screws with spring washers holding the power unit to the bottom casing.

CAUTION

Be sure to use the correct length spacer bolt when replacing the power unit. The two types of spacer bolts which are used in the power unit are almost the same length.

7. Remove the three spacer bolts holding the power unit to the bottom casing.



8. Disconnect the battery terminal assy connector from the power unit.

9. Remove the ferrite tape holding the thermistor wire to the battery compartment.

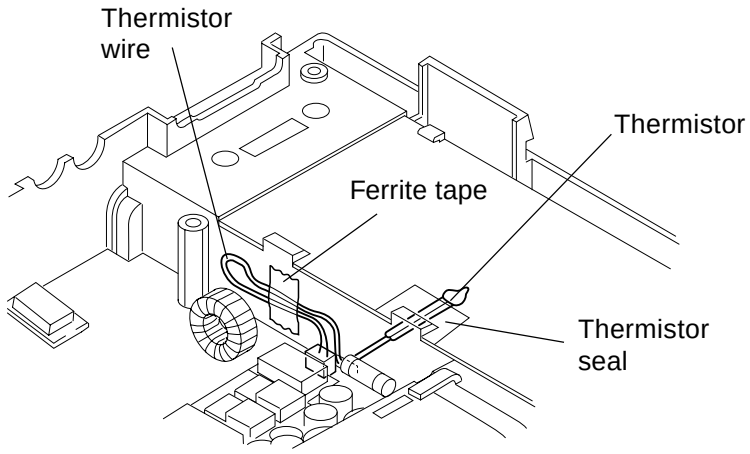
10. Remove the battery cover plate.

CAUTION

Do not completely lift off the power unit from the bottom casing before removing the thermistor. Otherwise, the thermistor wire will break.

11. Slightly lift up the power unit and pull out the thermistor from under the rechargeable battery.

12. After pulling out the thermistor, lift off the power unit from the bottom casing.



Replacing the Thermistor and Thermistor Cable

CAUTION

Observe the following when replacing the thermistor:

- **The thermistor wire must go under the thermistor seal as shown below. Positioning the thermistor wire over the thermistor seal results in incorrect temperature measurement or a damaged thermistor.**
- **To prevent incorrect temperature measurement, the thermistor must be positioned so that only the tip is just past the edge of the thermistor seal, as shown below.**

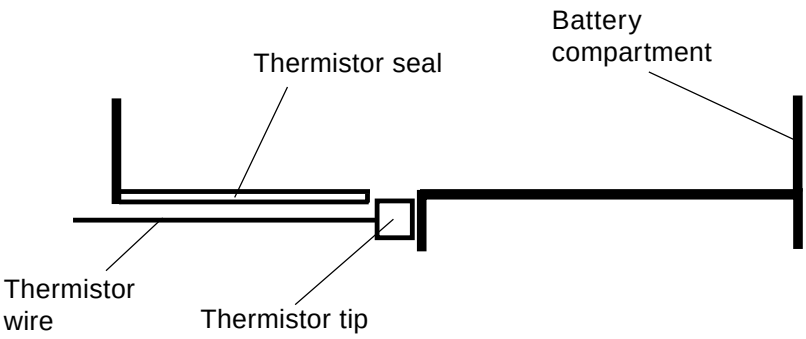
1. Replace the thermistor so that is in the correct position, as shown below.

CAUTION

The thermistor cable must be attached to the side of the battery compartment with the ferrite tape so that the thermistor cable is not put on the battery cover plate. This will cause the thermistor cable to be damaged.

2. Attach the thermistor cable to the side of the battery compartment with the ferrite tape as shown previously.

< Side view >



Removing the Battery Terminal Assy

1. Remove the top casing as described in the “Removing the Top Casing” secion.

2. Remove the LCD assy as described in the “Removing the LCD Assy” section. This step is for the ECG-9020K only.

3. Remove the inverter board as described in the “Removing the Inverter Board” section. This step is for the ECG-9020K only.

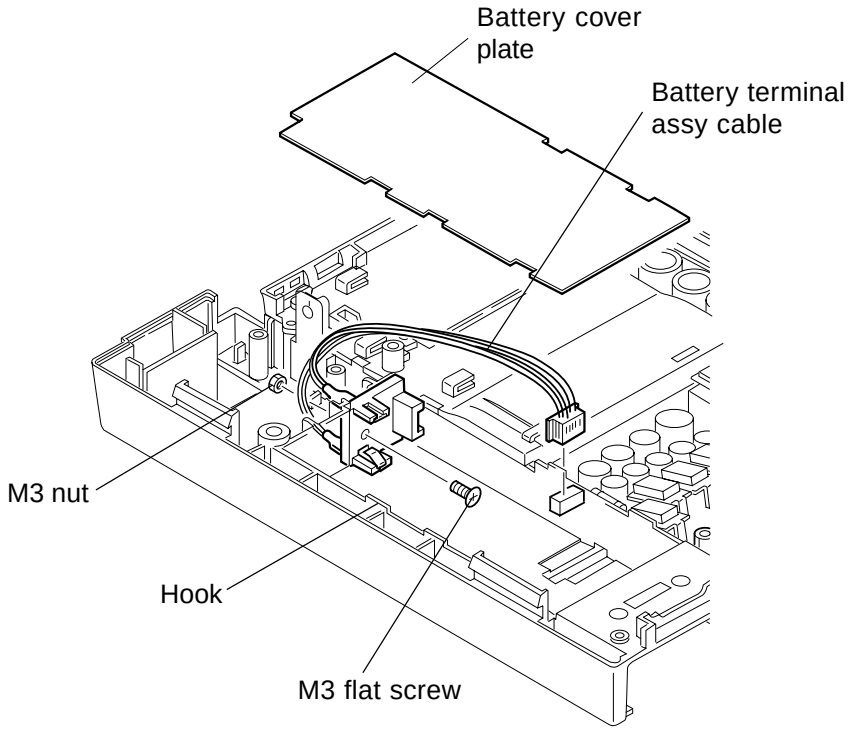
4. Remove the ECG control board as described in the “Removing the ECG Control Board” section.

5. Remove the Motor assy as described in the “Removing the Motor Assy” section.

6. Remove the battery cover plate. This plate is attached to the bottom casing by the five hooks on the bottom casing.

7. Remove the battery terminal assy cable from the cable hooks on the bottom casing.

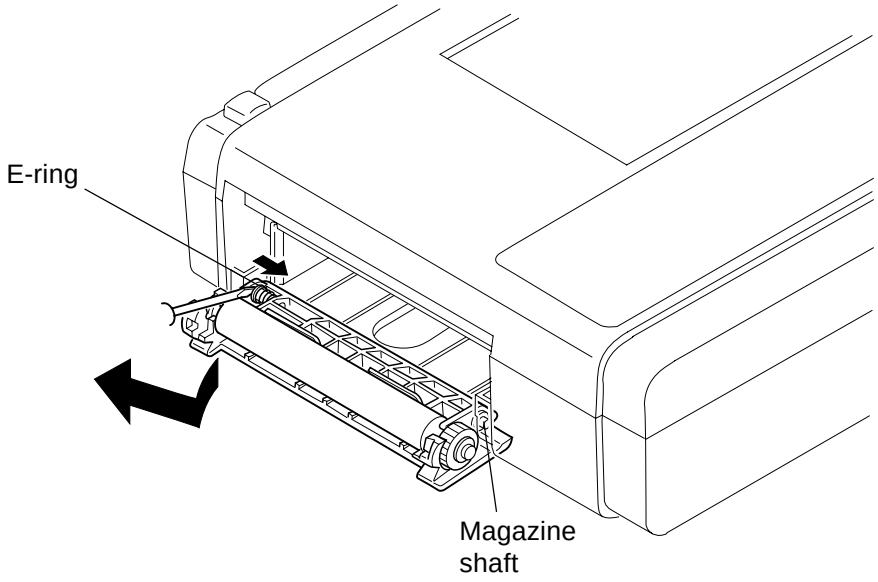
8. Remove the M3 flat screw and M3 nut.



Removing the Magazine Assy

Removal

Put the tip of the small flat-blade driver in the space between the E-ring and magazine chassis then push the E-ring in the direction of the smaller arrow shown below and pull off the magazine assy in the direction of the bigger arrow shown below.



Replacement

Put the plastic magazine shaft into the attachment hole and put the metal magazine shaft with the E-ring and spring into the attachment hole while pressing and holding down the shaft in the direction of the smaller arrow above.

Removing the Bottom Casing

NOTE

The instrument label is not attached to the bottom of the provided new bottom casing. If you want to attach the instrument label to the new bottom casing, send the damaged bottom casing, and we will provide the same instrument label at our price.

1. Remove the top casing as described in the “Removing the Top Casing” section.

2. Remove the LCD assy as described in the “Removing the LCD Assy” section. This step is for the ECG-9020K only.

3. Remove the inverter board as described in the “Removing the Inverter Board” section. This step is for the ECG-9020K only.

4. Remove the ECG control board as described in the “Removing the ECG Control Board” section.

5. Remove the Motor assy as described in the “Removing the Motor Assy” section.

6. Remove the power unit as described inthe “Removing the Power Unit” section.

7. Remove the battery terminal assy as described in the “Removing the Battery Terminal Assy” section.

8. Remove the magazine assy as described in the “Removing the Magazine Assy” section.

Replacing the Fuse on the Power Board

NOTE

A blown fuse indicates that there may be a faulty circuit in the instrument. Always check the instrument for the cause of the blown fuse before replacing the fuse.

The illustration below shows the location of four fuses inside the instrument. Three fuses are the same. Use the correct fuse only. The fuse rating is shown on the fuse holder.

1. Remove the top casing as described in the “Removing the Top Casing” section.

2. Remove the LCD assy as described in the “Removing the LCD Assy” section. This step is for the ECG-9020K only.

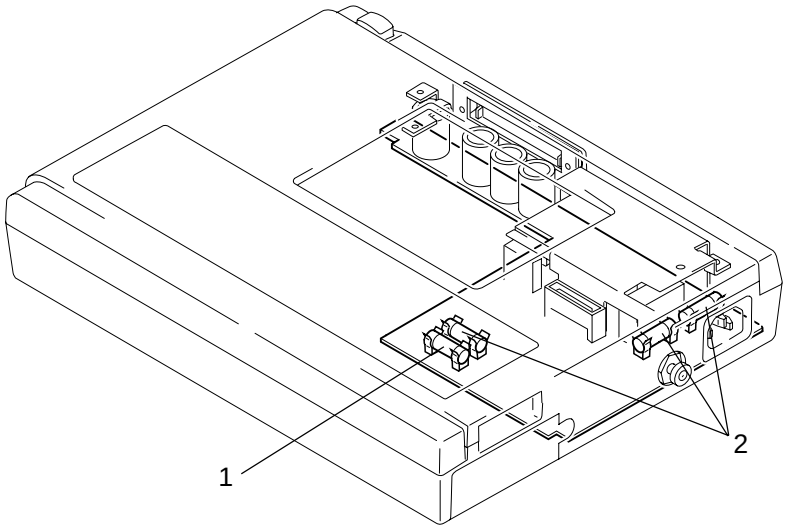
3. Remove the inverter board as described in the “Removing the Inverter Board” section. This step is for the ECG-9020K only.

4. Remove the ECG control board as described in the “Removing the ECG Control Board” section.

5. Remove the power unit as described in the “Removing the Power Unit” section.

6. Remove the blown fuse from the fuse bracket with the small flat-blade screwdriver.

Symbol	NK Code No.	Description
1	323241	218008, 8A
2	322893	218002, 2A



Replacing the Lithium Battery on the ECG Control Board

The lithium battery is used for backing up the system setup setting.

NOTE

Replace the lithium battery when the No. 08 or 09 system error message appears or after the lithium battery is used for approx. 7 years.

1. Remove the top casing as described in the “Removing the Top Casing” section.

2. Remove the LCD assy as described in the “Removing the LCD Assy” section. This step is for the ECG-9020K only.

3. Remove the LCD inverter board as described in the “Removing the LCD Inverter Board” section. This step is for the ECG-9020K only.

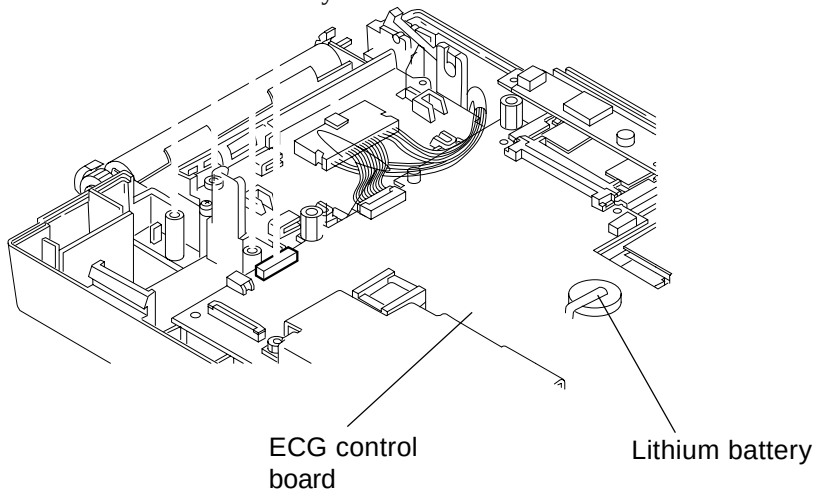
4. Remove the ECG control board as described in the “Removing the ECG Control Board” section.

5. Remove the expired lithium battery with a soldering iron and a pair of tweezers.

CAUTION

Be careful of the polarity of the lithium battery when soldering it. Incorrect attachment of the lithium battery causes the instrument to malfunction.

6. Solder a new lithium battery to the ECG control board.



Section 7 Replaceable Parts List

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Thermal Head Assy, YZ-011H8 ..... 7.8
Motor Assy, GC-0011 ..... 7.9
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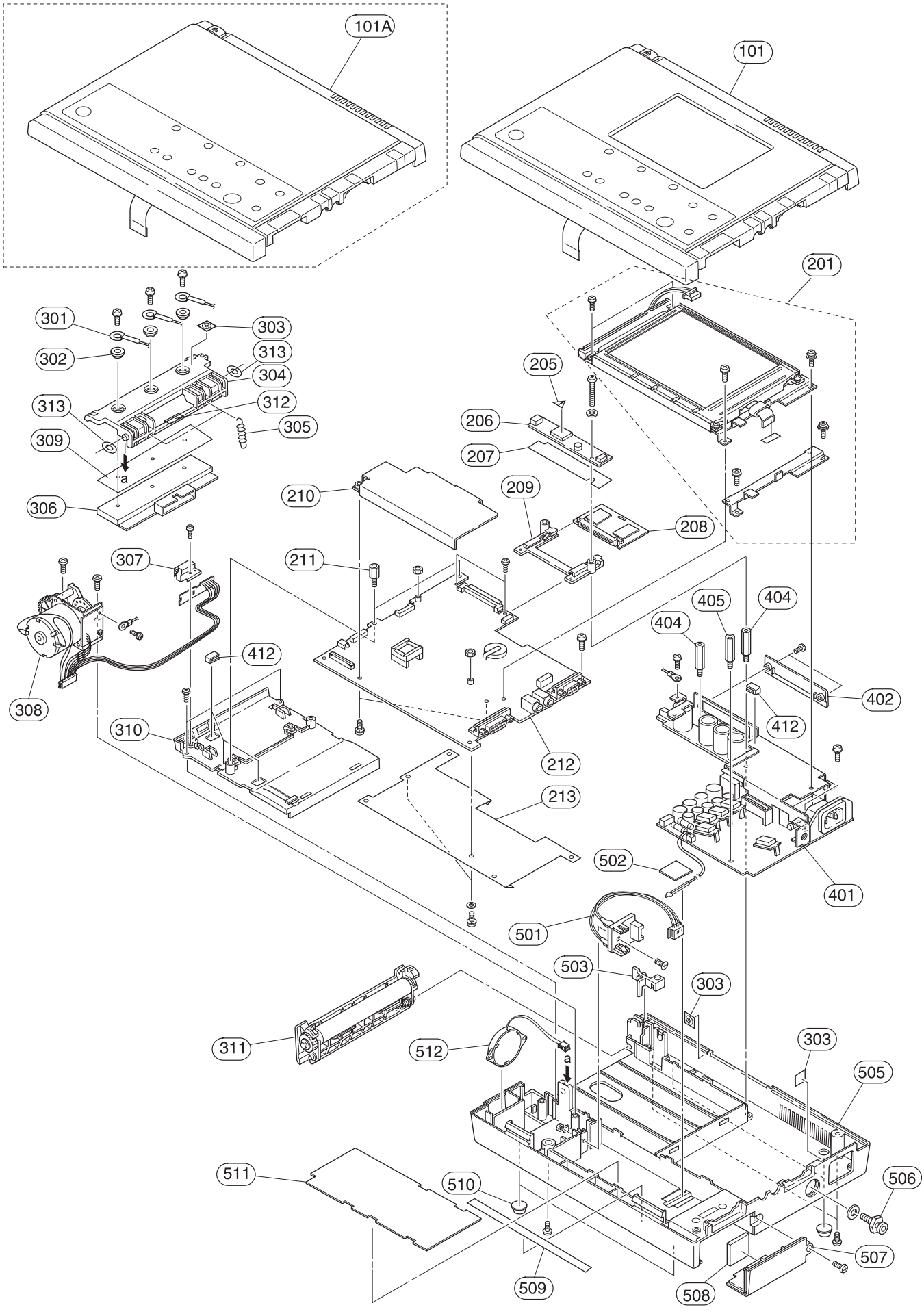
Patient Cable Hanger 7.14

When ordering parts or accessories from your nearest Nihon Kohden Corporation distributor, please quote the NK code number and part name which are listed in this service manual, and the name or model of the unit in which the required part is located. This will help us to promptly attend to your needs. Always use Nihon Kohden parts and accessories to assure maximum performance from your instrument.

General Parts List

Index	NK Code No.	Qty	Description
101	RK-0009	1	ECG-9020K top casing Assy
101A	RK-0007	1	ECG-9010K top casing Assy
201	VL-0001	1	LCD Assy
205	1124-037173	1	High voltage label
206	543984	1	Inverter board
207	6114-088371A	1	Shield sheet 1
208	UT-2357	1	Flash ROM board
209	6113-028492B	1	Flash ROM board guide
210	6113-028741B	1	Shield plate
211	6114-088335	2	Spacer bolt 1
212	UT-23561	1	ECG control board
213	6113-030453A	1	Shield sheet 2
301	6114-073378A	2	Ground lug
302	515284	3	Bearing B-F3-27
303	2229-000673	3	Power unit ground name plate
304	6112-010405A	1	Thermal head bracket
305	6114-088291A	2	Thermal head spring
306	YZ-011H8	1	Thermal head Assy
307	6114-088308A	1	Mark sensor BD earth plate
308	GC-0011	1	Motor Assy
309	6114-096077	1	Thermal head assy
310	6111-004405A	1	Recorder plate
311	RH-0001	1	Magazine Assy
312	6114-096086	1	Connector spacer
313	6114-097085	2	Thermal head bracket collar
401	SC-903D	1	Power unit
402	6114-087764A	1	Flash ROM board cover
404	6114-088326A	2	Spacer bolt 2
405	6114-088317A	1	Spacer bolt 3
412	547507	4	Mini clamp TMC-6
501	RK-0006	1	Battery terminal Assy
502	6114-088398A	1	Thermistor seal
503	6114-087862A	1	Release lever
505	6111-004388A	1	Bottom casing
506	6144-005993A	1	Ground terminal Assy
507	6113-028483A	1	Battery case cover
508	6114-094293	1	Battery case rubber
509	6114-088424A	1	Suction paper
510	547516	4	Rubber foot TM-166-12
511	6114-088406A	1	Battery cover plate
512	RK-0005	1	Speaker Assy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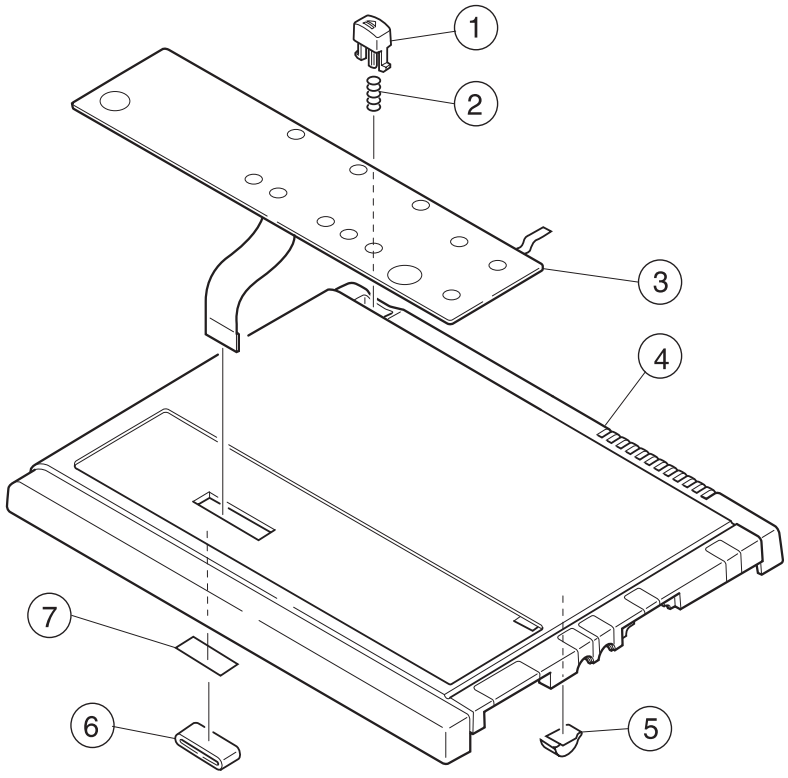
Top Casing Assy

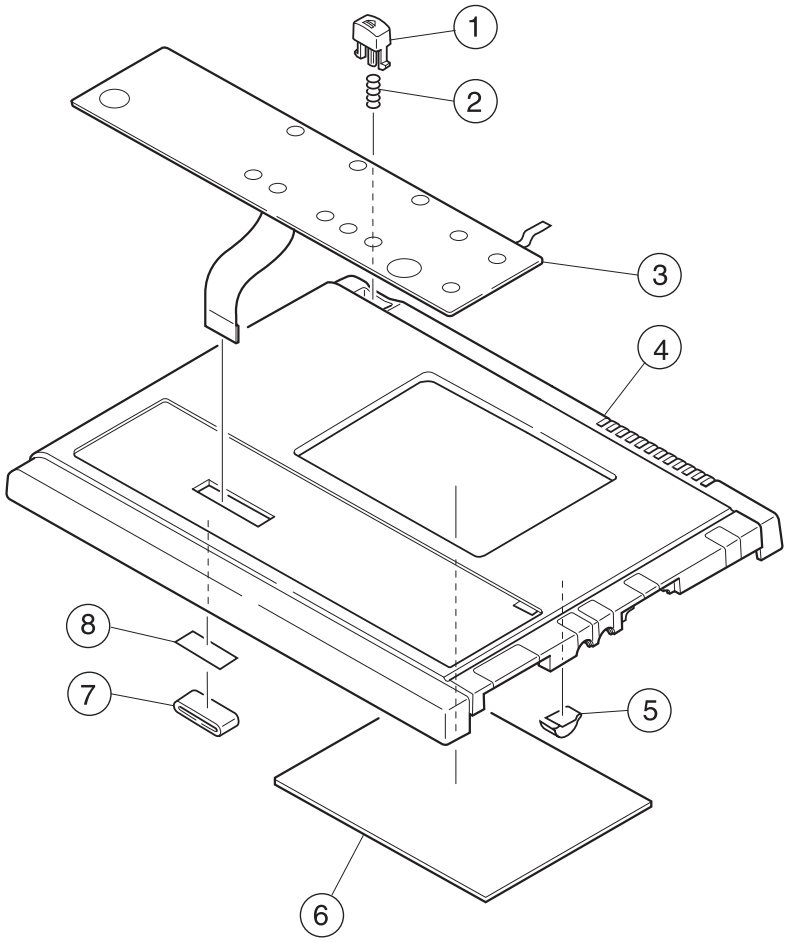
Top Casing Assy, RK-0007 for ECG-9010K

Index	NK Code No.	Qty	Description
1	6114-087853A	1	Release button
2	547525	1	Ultra spring C105
3	6143-008671	1	Operation panel Assy
4	6123-010278B	1	Top casing for ECG-9010K
5	6114-092731A	1	Membrane EMI spring
6	541914	1	Ferrite core FPC-24-12-3
7	6114-092749A	1	Ferrite tape



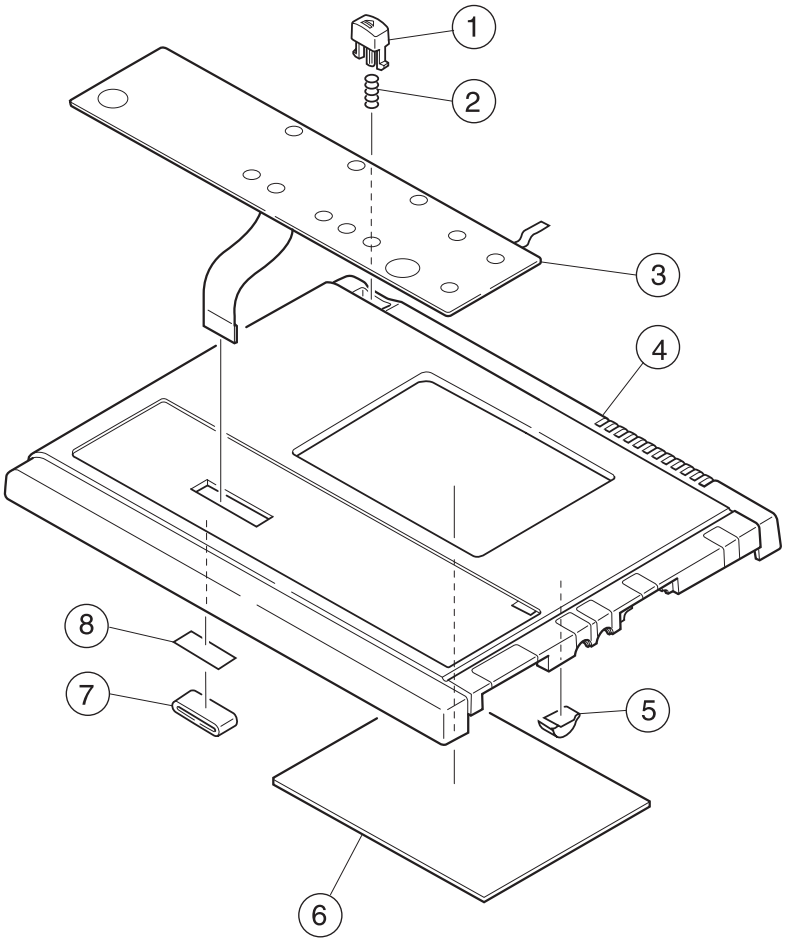
Top Casing Assy, RK-0009 for ECG-9020K

Index	NK Code No.	Qty	Description
1	6114-087853A	1	Release button
2	547525	1	Ultra spring C105
3	6143-008234B	1	Operation panel Assy for ECG-9020K
4	6123-010153A	1	Top casing for ECG-9020K
5	6114-092731A	1	Membrane EMI spring
6	6114-088362A	1	LCD filter
7	541914	1	Ferrite core FPC-24-12-3
8	6114-092749A	1	Ferrite tape



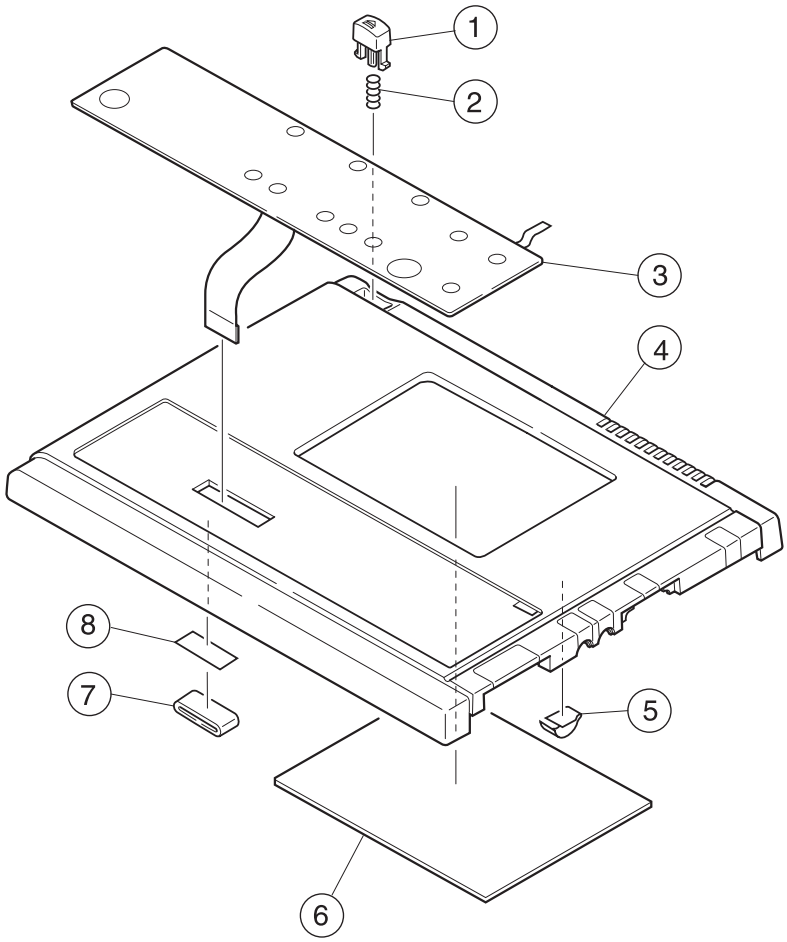
Top Casing Assy, RK-0044 for ECG-9020P

Index	NK Code No.	Qty	Description
1	6114-087853A	1	Release button
2	547525	1	Ultra spring C105
3	6143-011979	1	Operation panel Assy for ECG-9020P
4	6123-010153A	1	Top casing for ECG-9020K
5	6114-092731A	1	Membrane EMI spring
6	6114-088362A	1	LCD filter
7	541914	1	Ferrite core FPC-24-12-3
8	6114-092749A	1	Ferrite tape



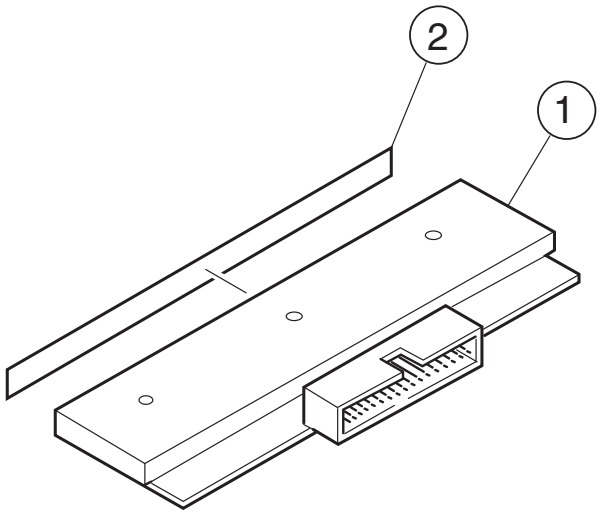
Top Casing Assy, RK-0058 for ECG-9022K

Index	NK Code No.	Qty	Description
1	6114-087853A	1	Release button
2	547525	1	Ultra spring C105
3	6143-012595	1	Operation panel Assy for ECG-9022K
4	6123-010153A	1	Top casing for ECG-9020K
5	6114-092731A	1	Membrane EMI spring
6	6114-088362A	1	LCD filter
7	541914	1	Ferrite core FPC-24-12-3
8	6114-092749A	1	Ferrite tape



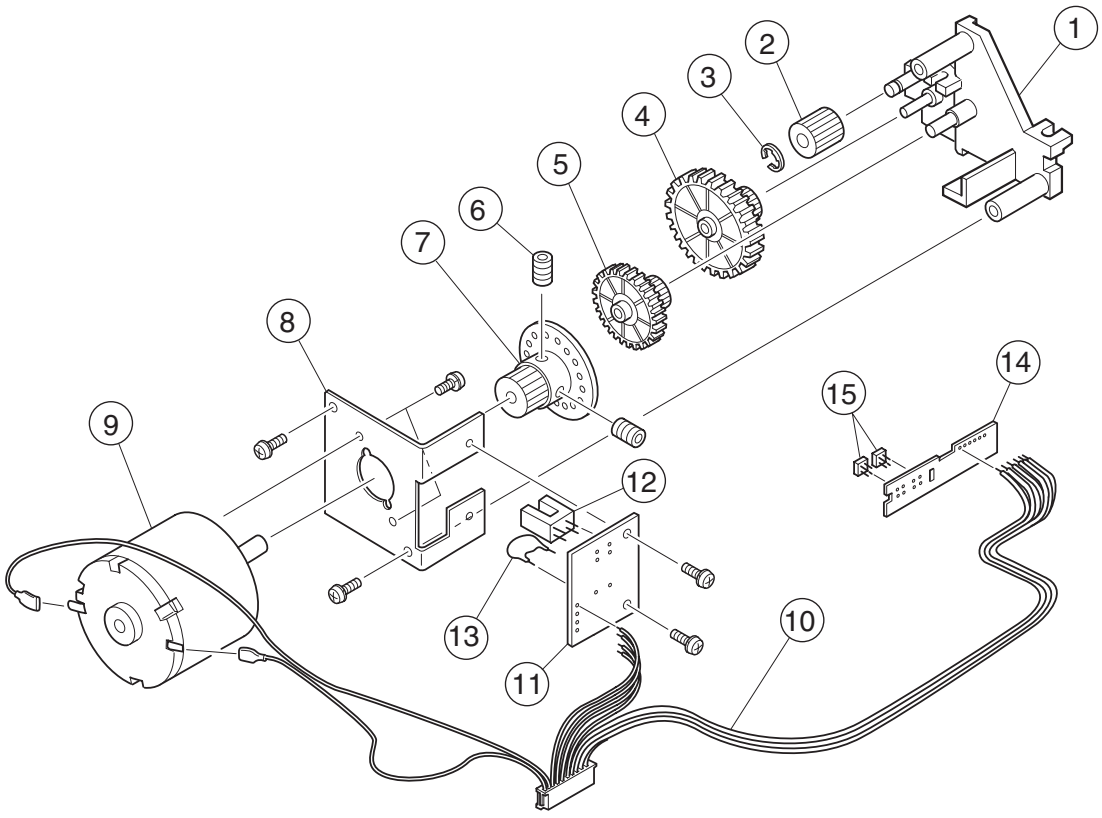
Thermal Head Assy, YZ-011H8

Index	NK Code No.	Qty	Description
1	541816	1	Thermal head KPT-104-8MGF1-NKC
2	6114-088389A	1	Shield sheet 3



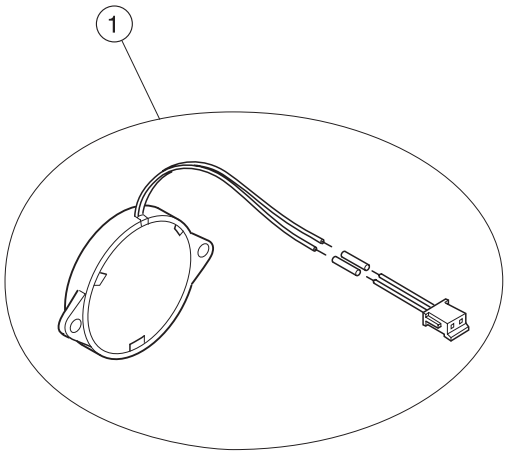
Motor Assy, GC-0011

Index	NK Code No.	Qty	Description
1	6113-028536A	1	Gear bracket
2	6114-087906A	1	Gear 2
3	106993	1	E-ring E-24
4	6114-087898A	1	Gear 1
5	6114-087915A	1	Gear 3
6	355108	1	Hexagon socket screw M2×4
7	6114-087889C	1	Motor gear
8	6114-088282A	1	Motor bracket
9	343975	1	Motor DN35-7306NIB
10	544002A	1	ZHR-12 motor cable (L120, 65)
11	6190-005844	1	Motor sensor board
12	387626	1	Photo-interrupter GP1A53HR
13	248438	1	Ceramic capacitor K104Z20Z5UF53H5
14	6190-016583	1	Mark sensor board
15	541834	1	Photo-reflector NJL5801K-F1



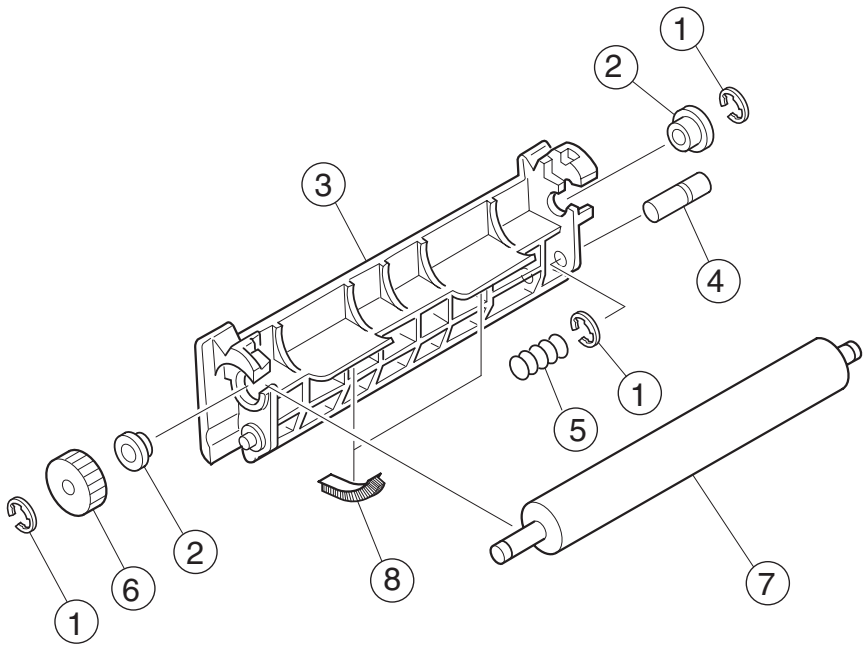
Speaker Assy, RK-0005

Index	NK Code No.	Qty	Description
1	0424-007654	1	RK-0005



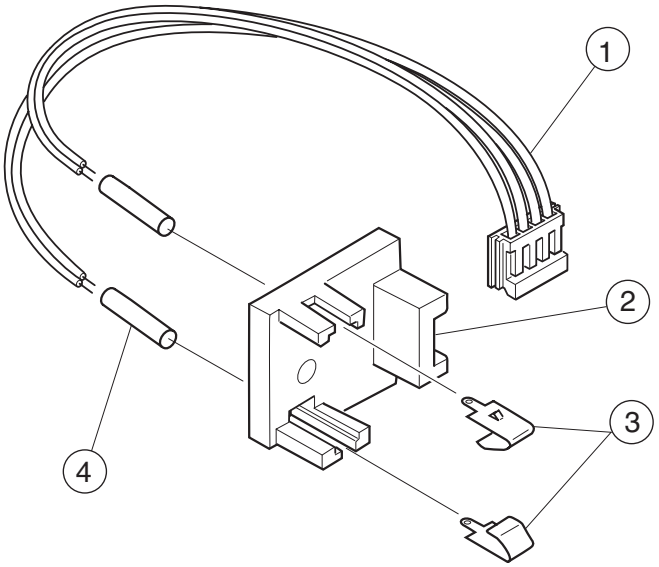
Magazine Assy, RH-0001

Index	NK Code No.	Qty	Description
1	107002	2	E-ring E-32
2	6114-088415A	2	Paper roller spacer
3	6112-010397A	1	Paper Magazine
4	6114-088353A	1	Paper magazine shaft
5	547534	1	Ultra spring C1477
6	6114-087871A	1	Paper roller gear
7	6113-028527A	1	Paper roller 14 (110)
8	6114-023887A	2	Brush



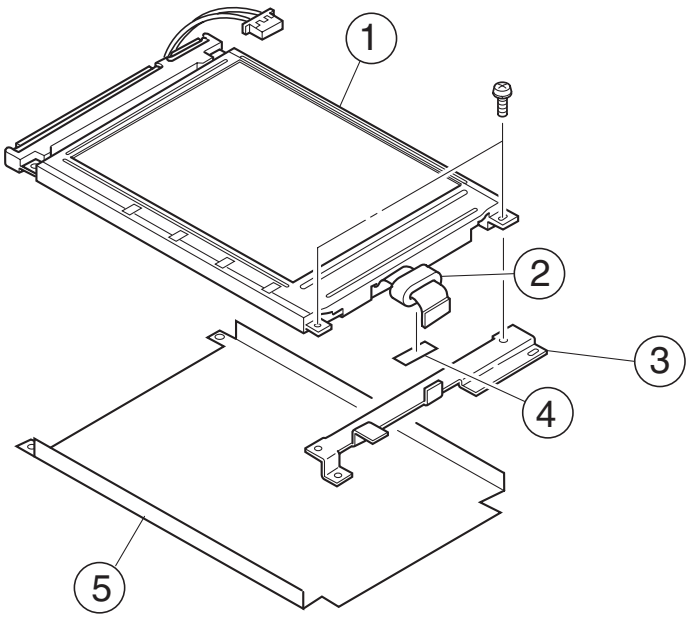
Battery Terminal Assy, RK-0006

Index	NK Code No.	Qty	Description
1	544011A	1	EHR-4 battery terminal cable (L150)
2	2113-013175B	1	Battery bracket
3	2114-040865A	2	Battery terminal
4	299784	1	Battery cable tube



LCD Assy, VL-0001

Index	NK Code No.	Qty	Description
1	545946	1	LCD module
2	541914	1	Ferrite
3	6114-092749A	1	Ferrite tape
4	6114-088344B	1	LCD holder
5	6144-092758A	1	LCD shield sheet

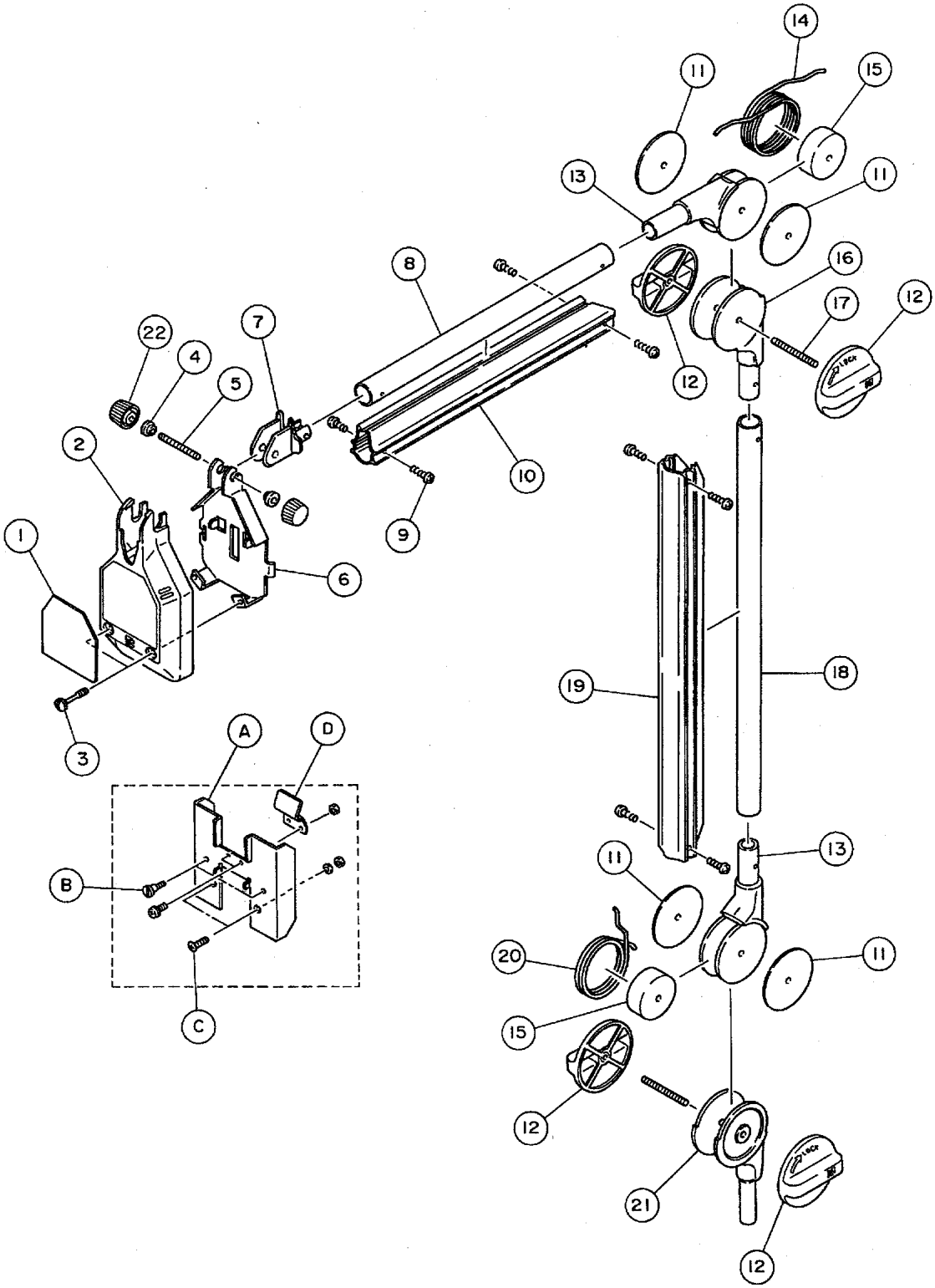


Patient Cable Hanger

Index	NK Code No.	Qty	Description
1	6124-202372	1	CH panel N*
2	6112-00 6045	1	CH cover N*
3	2219-013205	2	CH cover screw*
4	2219-013214	2	CH knob spacer
5	2114-038707A	1	CH arm screw
6	6113-016941	1	CH base plate N
7	6113-016879A	1	CH joint DN
8	6113-016888	1	CH pipe 3N
9	398855	8	Taping screw M3×8
10	6113-016905	1	CH pipe cover. 1N
11	2114-038814B	4	CH joint spacer
12	6113-016923	4	CH knob not. 3N
13	6114-052392	2	CH joint AN
14	2114-038672B	1	CH top arm screw
15	2219-011858	1	CH spring axle. 3
16	6114-052409	1	CH joint BN
17	289768	2	CH hexagon socket bolt M4×50
18	6113-016897	1	CH pipe. 4N
19	6113-016914	1	CH pipe cover. 2N
20	2114-038681B	1	CH bottom arm screw
21	6114-052427	1	CH joint CN
22	6113-016932	1	CH knob nut. 4N
A	6113-011901	1	CH input box connector
B	6114-035999	2	CH guide pin
C	283702	2	ISO flat-head screw(M3×6)
D	6114-036008	1	Bracket spring

NOTE

The parts marked with * are replaced by parts A, B and C when the Input Box is used.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12

Section 8 Connector Pin Assignment

Power Unit 8.1
CN11 (to AC Inlet) 8.1
CN21 (to ECG control board) 8.1
CN31 (to Thermal Head) 8.1
CN51 (to Battery) 8.1
ECG Control Board 8.2
CNJ011 (to Thermal Head) 8.2
CNJ012 (to Inverter Board) 8.2
CNJ013 (to LCD) 8.3
CNJ021 (to Flash ROM Board) 8.3
CNJ031 (to SIO Connector) 8.5
CNJ032 (to Key Connector) 8.5
CNJ033 (to Speaker) 8.6
CNJ035 (to Power Unit) 8.7
CNJ036 (to Motor) 8.8
CNJ041 (to CRO Connector) 8.8
CNJ043 (to EXT INPUT Connector) 8.8
CNJ091 (to ECG Connector) 8.9
Flash ROM Board 8.10
CNJ021 (to ECG Control Board) 8.10
Inverter Board 8.12
CN1 (to ECG Control Borad) 8.12
CN2 (to LCD module) 8.12
External Input/Output Socket 8.13
SIO Socket 8.13
EXT Input and CRO Output 8.13

Power Unit

CN11 (to AC Inlet)

Pin No.	Signal name	Description
1	AC	AC power
2	DGND	Ground
3	AC	AC power

CN21 (to ECG control board)

Pin No.	Signal name	Description	Pin No.	Signal name	Description
1	DGND	Ground for logic circuit	16	PWROVER	
2	DGND	Ground for logic circuit	17	SPOFF	
3	DGND	Ground for logic circuit	18	HEADRST	
4	DGND	Ground for logic circuit	19	DCXAC	
5	DGND	Ground for logic circuit	20	OFFKEY	
6	DGND	Ground for logic circuit	21	CHGLEDA	
7	DGND	Ground for logic circuit	22	CHGLEDK	
8	DGND	Ground for logic circuit	23	ACLED	
9	DGND	Ground for logic circuit	24	POWERSW	
10	DGND	Ground for logic circuit	25	NF5V	
11	DGND	Ground for logic circuit	26	NF5V	
12	DGND	Ground for logic circuit	27	NF5V	
13	DGND	Ground for logic circuit	28	DCPOWER	
14	DGND	Ground for logic circuit	29	DCPOWER	
15	DGND	Ground for logic circuit	30	AGNDSND	

CN31 (to Thermal Head)

Pin No.	Signal name	Description	Pin No.	Signal name	Description
1	+24 V	+24 V for thermal head	7	+24VGND	Ground for thermal head
2	+24 V	+24 V for thermal head	8	+24VGND	Ground for thermal head
3	+24 V	+24 V for thermal head	9	+24VGND	Ground for thermal head
4	+24 V	+24 V for thermal head	10	+24VGND	Ground for thermal head
5	+24 V	+24 V for thermal head	11	+24VGND	Ground for thermal head
6	+24 V	+24 V for thermal head	12	+24VGND	Ground for thermal head

CN51 (to Battery)

Pin No.	Signal name	Description	Pin No.	Signal name	Description
1	BATT+	Battery power (+)	3	BATT–	Battery power (–)
2	BATT+	Battery power (+)	4	BATT–	Battery power (–)

ECG Control Board

CNJ011 (to Thermal Head)

Model: 63261-1490

Pin No.	Signal name	Direction	Description
1	THLATCH	Output	Data latch output to thermal head
2	THDATA	Output	Print data to thermal head
3	XSTROPE1	Output	Thermal head driver enable output
4	XSTROPE1	Output	Thermal head driver enable output
5	XSTROPE1	Output	Thermal head driver enable output
6	XSTROPE1	Output	Thermal head driver enable output
7	XSTROPE1	Output	Thermal head driver enable output
8	XSTROPE1	Output	Thermal head driver enable output
9	THERM	Input	Thermal head temperature input detected by thermistor
10	DGND		Ground for digital circuit
11	+5 V		+5 V for digital circuit
12	+5 V		+5 V for digital circuit
13	THSCLK	Output	Data shift output to thermal head
14	NC		Not connected

CNJ012 (to Inverter Board)

Model: 53261-0690

Pin No.	Signal name	Direction	Description
1	VIN	Output	+10.4 to 12 V for backlight
2	GND		Ground
3	VREMOTE	Output	Backlight On/Off output (0 V: Not light, + 5 V: Light)
4	VBRIGHT	Output	Backlight brightness control output (0 V: when bright is set to maximum)
5	NC		Not connected
6	XLCD	Input	LCD identification input

CNJ013 (to LCD)

Model: FH3-12S-1.25DSA

Pin No.	Signal name	Direction	Description
1	S	Output	Scannning start output
2	CP1	Output	Input data latch ouput
3	CP2	Output	Data input clock output
4	NC		Not connected
5	LCDON	Output	Display control output (“L” = OFF)
6	LCD [0]	Output	Display data output [0]
7	LCD [1]	Output	Display data output [1]
8	LCD [2]	Output	Display data output [2]
9	LCD [3]	Output	Display data output [3]
10	+5 V	Output	+5 V for logic circuit
11	DGND		Ground for digital circuit
12	+28 V	Output	+17 to 26 V for driving LCD

CNJ021 (to Flash ROM Board)

Model: 87BFN-080R

Pin No.	Signal name	Direction	Description
1	DGND		Ground for digital circuit
2	DGND		Ground for digital circuit
3	+5 V		+5 V for logic circuit
4	XCSRO1	Output	Chip select 1 for ROM (Address: $000000 to $0FFFFF)
5	XCSRO2	Output	Chip select 2 for ROM (Address: $100000 to $1FFFFF)
6	SROMC	Output	Serial ROM clock output
7	SROMR	Output	Serial ROM clock output
8	LA [00]	Output	Address bus
9	LA [01]	Output	Address bus
10	LA [02]	Output	Address bus
11	LA [03]	Output	Address bus
12	LA [04]	Output	Address bus
13	LA [05]	Output	Address bus
14	LA [06]	Output	Address bus
15	LA [07]	Output	Address bus
16	LA [08]	Output	Address bus
17	LA [09]	Output	Address bus
18	LA [10]	Output	Address bus
19	LA [11]	Output	Address bus
20	LA [12]	Output	Address bus
21	LA [13]	Output	Address bus
22	LA [14]	Output	Address bus
23	LA [15]	Output	Address bus
24	LA [16]	Output	Address bus
25	LA [17]	Output	Address bus
26	LA [18]	Output	Address bus

Pin No.	Signal name	Direction	Description
27	LA [19]	Output	Address bus
28	LD [08]	Input/Output	Data bus
29	LD [09]	Input/Output	Data bus
30	LD [10]	Input/Output	Data bus
31	LD [11]	Input/Output	Data bus
32	LD [12]	Input/Output	Data bus
33	LD [13]	Input/Output	Data bus
34	LD [14]	Input/Output	Data bus
35	XRESET	Output	Reset output
36	XDSACK0	Output	Output for system test
37	XDSACK1	Output	Output for system test
38	XOE	Output	Read output
39	XWE	Output	Write output
40	XBERR	Output	Output for system test
41	LA [22]	Output	Address bus
42	LA [21]	Output	Address bus
43	SROMD	Input	Serial ROM data
44	LA [20]	Output	Address bus
45	LA [23]	Output	Address bus
46	FC [0]	Out put	Output for system test
47	FC [1]	Out put	Output for system test
48	FC [2]	Out put	Output for system test
49	LA [26]	Output	Address bus
50	LA [25]	Output	Address bus
51	LA [24]	Output	Address bus
52	SIZ0	Output	Output for system test
53	SIZ1	Output	Output for system test
54	XAS	Output	Output for system test
55	RXW	Output	Output for system test
56	LD [07]	Input/Output	Data bus
57	LD [06]	Input/Output	Data bus
58	LD [05]	Input/Output	Data bus
59	LD [04]	Input/Output	Data bus
60	LD [03]	Input/Output	Data bus
61	LD [02]	Input/Output	Data bus
62	LD [01]	Input/Output	Data bus
63	LD [00]	Input/Output	Data bus
64	LD [23]	Input/Output	Data bus
65	LD [22]	Input/Output	Data bus
66	LD [21]	Input/Output	Data bus
67	LD [20]	Input/Output	Data bus
68	LD [19]	Input/Output	Data bus
69	LD [18]	Input/Output	Data bus
70	LD [17]	Input/Output	Data bus
71	LD [16]	Input/Output	Data bus
72	LD [27]	Input/Output	Data bus
73	LD [28]	Input/Output	Data bus
74	LD [29]	Input/Output	Data bus

Pin No.	Signal name	Direction	Description
75	LD [30]	Input/Output	Data bus
76	LD [31]	Input/Output	Data bus
77	LD [15]	Input/Output	Data bus
78	+5 V		+5 V for logic circuit
79	DGND		Ground for digital circuit
80	DGND		Ground for digital circuit

CNJ031 (to SIO Connector)

Model: JEY-9S-1A28

Pin No.	Signal name	Direction	Description
1	FG		Ground for main unit
2	TXD	Output	Transmission data
3	RXD	Input	Receiving data
4	RTS	Output	Request to send
5	CTS	Input	Clear to send
6	DSR	Input	Data set ready
7	GND		Ground for signal
8	HS	Input	With modem = DCD Without modem = Short to 4-pin
9	DTR	Output	Data terminal ready

CNJ032 (to Key Connector)

Model: S2B-ZR

Pin No.	Signal name	Direction	Description
1	SPKOUT	Output	Speaker output
2	AGNDSND		Ground for speaker

CNJ033 (to Speaker)

Model: 52559-4092

Pin No.	Signal name	Direction	Description
1	+5 V	Output	+5 V for logic circuit
2	+5 V	Output	+5 V for logic circuit
3	LED [00]	Output	LED display output
4	LED [01]	Output	LED display output
5	LED [02]	Output	LED display output
6	QRS	Output	QRS display LED output
7	LED [04]	Output	LED display output
8	FILTER	Output	Filter display LED output
9	LED [06]	Output	LED display output
10	LED [07]	Output	LED display output
11	LED [08]	Output	LED display output
12	LED [09]	Output	LED display output
13	LED [10]	Output	LED display output
14	LED [11]	Output	LED display output
15	LED [12]	Output	LED display output
16	LED [13]	Output	LED display output
17	LED [14]	Output	LED display output
18	LED [15]	Output	LED display output
19	LED [16]	Output	LED display output
20	LED [03]	Output	LED display output
21	ONLED	Output	LED display output at power-on
22	LED [05]	Output	LED display output
23	ACLED	Output	LED display output for AC power
24	DGND		Ground for digital circuit
25	CHGLEDK	Output	Charging display LED cathode output
26	CHGLEDA	Output	Charging display LED anode output
27	PSW	Input	Power switch
28	DGND		Ground for digital circuit.
29	K00	Input	Keyboatd input
30	K01	Input	Keyboard input
31	K02	Input	Keyboard input
32	K03	Input	Keyboard scan input
33	KS0	Output	Keyboard scan input
34	KS1	Output	Keyboard scan input
35	KS2	Output	Keyboard scan input
36	NC		Not connected
37	NC		Not connected
38	NC		Not connected
39	NC		Not connected
40	NC		Not connected

CNJ035 (to Power Unit)

Model: TX24-30P-12ST-H1

Pin No.	Signal name	Direction	Description
1	DGND		Ground for logic circuit
2	DGND		Ground for logic circuit
3	DGND		Ground for logic circuit
4	DGND		Ground for logic circuit
5	DGND		Ground for logic circuit
6	DGND		Ground for logic circuit
7	DGND		Ground for logic circuit
8	DGND		Ground for logic circuit
9	DGND		Ground for logic circuit
10	DGND		Ground for logic circuit
11	DGND		Ground for logic circuit
12	DGND		Ground for logic circuit
13	DGND		Ground for logic circuit
14	DGND		Ground for logic circuit
15	DGND		Ground for logic circuit
16	PWOVER	Input	Power overheat input
17	POFF	Output	Power-off output
18	HDOVER	Input	Thermal head power over-current input
19	DCXAC	Input	Battery operation status input
20	OFFKEY	Input	Power-off request input
21	CHGLEDA	Input	Charging display LED input
22	CHGLEDK	Input	Charging display LED inut
23	ACLED	Input	AC power display LED input
24	PSW	Output	Power ON/OFF switch
25	+5 V		+5 V for logic circuit
26	+5 V		+5 V for logic circuit
27	+5 V		+5 V for logic circuit
28	+12 V		+12 V for analog circuit
29	+12 V		+12 V for analog circuit
30	AGNDSND		Ground for sound circuit

CNJ036 (to Motor)

Model: B12B-ZR

Pin No.	Signal name	Direction	Description
1	+5 V		+5 V for paper empty/mark sensor
2	PAEMP	Input	Paper empty snsor input
3	PAMARK	Input	Mark sensor input
4	DGND		Ground for paper empty/mark sensor
5	M	Output	Paper empty sensor LED output
6	+5 VR301	Output	Mark sensor LED output
7	+5 V		
8	DGND		Ground for digital circuit
9	+5 VR499		LED signal for sensor which detects number of motor rotation
10	MOTRET		Detection input of number of motor rotation
11	MOTPP		Motor power (+)
12	MOTPM		Motor power (−)

CNJ041 (to CRO Connector)

Model: SG8036

Pin No.	Signal name	Direction	Description
1	CRO		External signal output (0.5 V/10 mm)
2	AGND		Ground for analog circuit

CNJ043 (to EXT INPUT Connector)

Model: SG8036

Pin No.	Signal name	Direction	Description
1	EXT-IN		External signal input (10 mm/0.5 V)
2	AGND		Ground for analog circuit

CNJ091 (to ECG Connector)

Model: JAY-15S-1A28

Pin No.	Signal name	Direction	Description
1	C2	Input	ECG signal input
2	C3	Input	ECG signal input
3	C4	Input	ECG signal input
4	C5	Input	ECG signal input
5	C6	Iutput	ECG signal input
6	SHIELD		Cable shield
7	NC		Not connected
8	NC		Not connected
9	R	Input	ECG signal input
10	L	Input	ECG signal input
11	F	Input	ECG signal input
12	C1	Input	ECG signal input
13	NC		Not connected
14	RF	Input	ECG signal input
15	NC		Not connected

Flash ROM Board

CNJ021 (to ECG Control Board)

Model: 87BMN-080R

Pin No.	Signal name	Direction	Description
1	DGND		Ground for digital circuit
2	DGND		Ground for digital circuit
3	+5 V		+5 V for logic circuit
4	XCSRO1	Output	Chip select 1 for ROM (Address: $000000 to $0FFFFF)
5	XCSRO2	Output	Chip select 2 for ROM (Address: $100000 to $1FFFFF)
6	SROMC	Output	Serial ROM clock output
7	SROMR	Output	Serial ROM clock output
8	LA [00]	Output	Address bus
9	LA [01]	Output	Address bus
10	LA [02]	Output	Address bus
11	LA [03]	Output	Address bus
12	LA [04]	Output	Address bus
13	LA [05]	Output	Address bus
14	LA [06]	Output	Address bus
15	LA [07]	Output	Address bus
16	LA [08]	Output	Address bus
17	LA [09]	Output	Address bus
18	LA [10]	Output	Address bus
19	LA [11]	Output	Address bus
20	LA [12]	Output	Address bus
21	LA [13]	Output	Address bus
22	LA [14]	Output	Address bus
23	LA [15]	Output	Address bus
24	LA [16]	Output	Address bus
25	LA [17]	Output	Address bus
26	LA [18]	Output	Address bus
27	LA [19]	Output	Address bus
28	LD [08]	Input/Output	Data bus
29	LD [09]	Input/Output	Data bus
30	LD [10]	Input/Output	Data bus
31	LD [11]	Input/Output	Data bus
32	LD [12]	Input/Output	Data bus
33	LD [13]	Input/Output	Data bus
34	LD [14]	Input/Output	Data bus
35	XRESET	Output	Reset
36	XDSACK0	Output	Output for system test
37	XDSACK1	Output	Output for system test
38	XOE	Output	Read output

Pin No.	Signal name	Direction	Description
38	XOE	Output	Read output
39	XWE	Output	Write output
40	XBERR	Output	Output for system test
41	LA [22]	Output	Address bus
42	LA [21]	Output	Address bus
43	SROMD	Input	Serial ROM data
44	LA [20]	Output	Address bus
45	LA [23]	Output	Address bus
46	FC [0]	Out put	Output for system test
47	FC [1]	Out put	Output for system test
48	FC [2]	Out put	Output for system test
49	LA [26]	Output	Address bus
50	LA [25]	Output	Address bus
51	LA [24]	Output	Address bus
52	SIZ0	Output	Output for system test
53	SIZ1	Output	Output for system test
54	XAS	Output	Output for system test
55	RXW	Output	Output for system test
56	LD [07]	Input/Output	Data bus
57	LD [06]	Input/Output	Data bus
58	LD [05]	Input/Output	Data bus
59	LD [04]	Input/Output	Data bus
60	LD [03]	Input/Output	Data bus
61	LD [02]	Input/Output	Data bus
62	LD [01]	Input/Output	Data bus
63	LD [00]	Input/Output	Data bus
64	LD [23]	Input/Output	Data bus
65	LD [22]	Input/Output	Data bus
66	LD [21]	Input/Output	Data bus
67	LD [20]	Input/Output	Data bus
68	LD [19]	Input/Output	Data bus
69	LD [18]	Input/Output	Data bus
70	LD [17]	Input/Output	Data bus
71	LD [16]	Input/Output	Data bus
72	LD [27]	Input/Output	Data bus
73	LD [28]	Input/Output	Data bus
74	LD [29]	Input/Output	Data bus
75	LD [30]	Input/Output	Data bus
76	LD [31]	Input/Output	Data bus
77	LD [15]	Input/Output	Data bus
78	+5 V		+5 V for logic circuit
79	DGND		Ground for digital circuit
80	DGND		Ground for digital circuit

Inverter Board

CN1 (to ECG Control Borad)

Pin No.	Signal name	Direction	Description
1	VIN	Output	+10.4 to 12 V for backlight
2	GND		Ground
3	VREMOTE	Output	Backlight On/Off output (0 V: Not light, +5 V: Light)
4	VBRIGHT	Output	Backlight brightness control output (0 V: when bright is set to maximum)
5	NC		Not connected
6	XLCD	Input	LCD identification input

CN2 (to LCD module)

Pin No.	Signal name	Direction	Description
1	Iout	Output	Power for backlight
2	NC		Not connected
3	Ioutreturn	Input	Power for backlight

External Input/Output Socket

SIO Socket

Pin No.	Signal name	Direction	Description
1	FG		Ground for main unit
2	TXD	Output	Transmission data
3	RXD	Input	Receiving data
4	RTS	Output	Request to send
5	CTS	Input	Clear to send
6	DSR	Input	Data set ready
7	GND		Ground for signal
8	HS	Input	With modem = DCD
			Without modem = Short to 4-pin
9	DTR	Output	Data terminal ready

Main Unit Side Connector on ECG Control Board
Connector model: NK code No. JEY-9S-1A2B

Mating Connector
Connector: DE-9P (NK Code No. 079362)
Case: DE-C1-J6 (NK Code No. 080788)

EXT Input and CRO Output

Main Unit Side Connector on ECG Control Board
Connector model: NK code No. SG8036

Mating Connector
Mini plug: AP-313 (NK Code No. 355456A)

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The model and serial number of your instrument are identified on the rear or bottom of the unit. Write the model and serial number in the spaces provided below. Whenever you call your distributor concerning this instrument, mention these two pieces of information for quick and accurate service.

Model _____ **Serial number** _____

Your Distributor

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